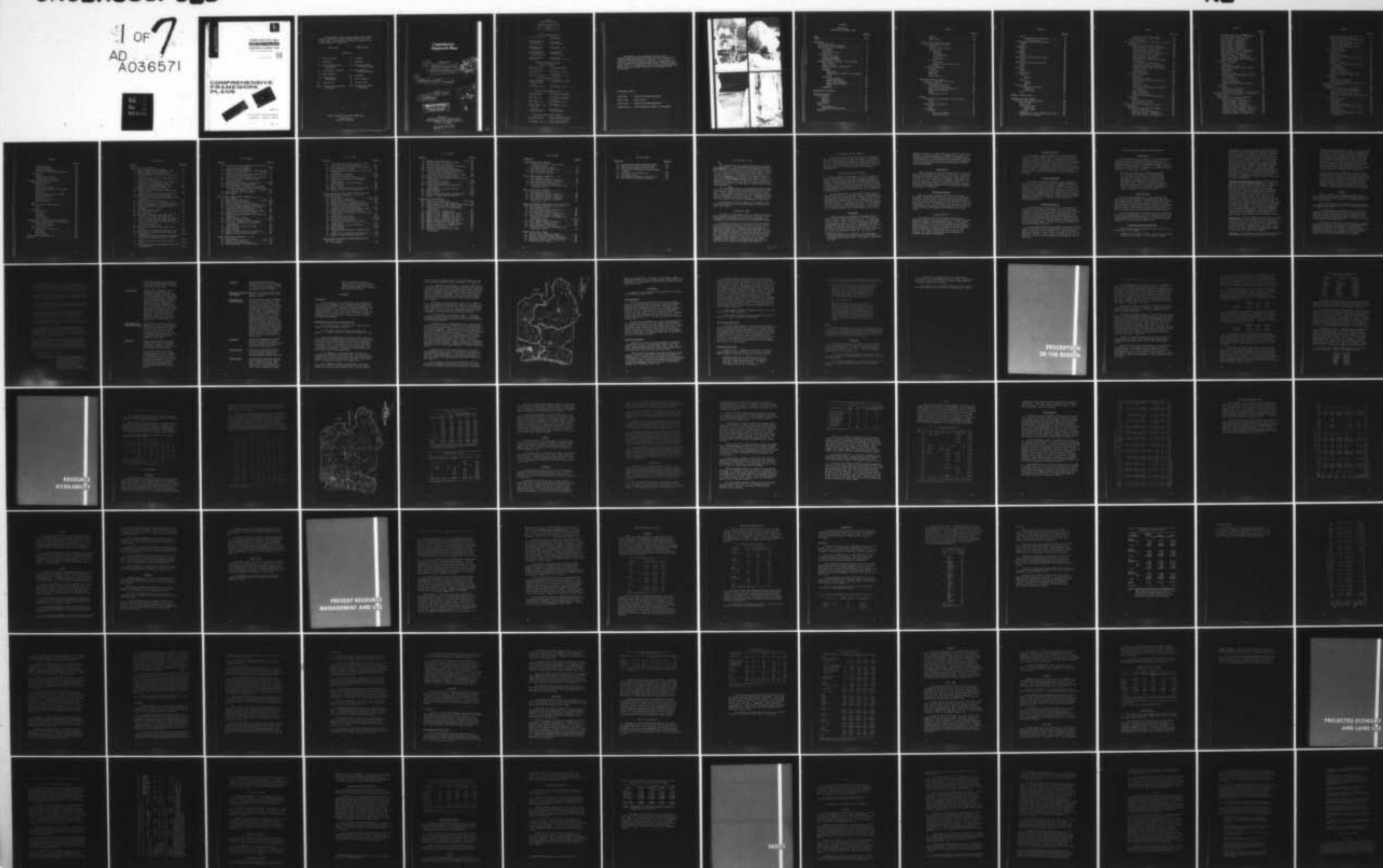
AD-A036 571 PACIFIC NORTHWEST RIVER BASINS COMMISSION VANCOUVER WASH F/G 8/6
COLUMBIA-NORTH PACIFIC REGION COMPREHENSIVE FRAMEWORK STUDY OF --ETC(U)
JUN 72 E J GULLIDGE, H H RALPHS, C STEWART

UNCLASSIFIED NL

1 OF 7
AD
A036571



Columbia-North Pacific Region

Comprehensive Framework Study
of Water and Related Lands

APPENDIX XVI

COMPREHENSIVE FRAMEWORK PLANS

SUBMITTED BY

PACIFIC NORTHWEST RIVER BASINS COMMISSION
1 COLUMBIA RIVER, VANCOUVER, WASHINGTON

JUNE 1972

This appendix is one of a series making up the complete Columbia-North Pacific Region Framework Study on water and related lands. The results of the study are contained in the several documents as shown below:

Main Report

Summary Report

Appendices

I. History of Study

II. The Region

III. Legal & Administrative Background

IV. Land & Mineral Resources

V. Water Resources

VI. Economic Base & Projections

VII. Flood Control

VIII. Land Measures & Watershed Protection

IX. Irrigation

X. Navigation

XI. Municipal & Industrial Water Supply

XII. Water Quality & Pollution Control

XIII. Recreation

XIV. Fish & Wildlife

XV. Electric Power

XVI. Comprehensive Framework Plans

Pacific Northwest River Basins Commission
1 Columbia River
Vancouver, Washington

Comprehensive Framework Plans

(1)

APPENDIX XVI

(6) Columbia-North Pacific Region
Comprehensive Framework Study
of Water and Related Lands. Appendix XVI.
Comprehensive Framework Plans,

(10) E. J./Gullidge, H. H./Ralphs,
Clyde/Stewart, W. A./Post G. J./Gronewald

(11) June 1972

(12) 612p.

Prepared by
Columbia-North Pacific Technical Staff
Pacific Northwest River Basins Commission
Vancouver, Washington

410 072

LB

APPENDIX XVI
Comprehensive Framework Plans

Prepared under the direction of the
Columbia-North Pacific Technical Staff
by the
Regional Plan Formulation Task Force
and the
Subregional Plan Formulation Task Forces

REGIONAL PLAN FORMULATION TASK FORCE

E. J. Gullidge, Chairman

Department of Agriculture
H. H. Ralphs, SCS
Clyde Stewart, ERS
(Alt.) W. A. Post, FS

Department of the Army
G. J. Gronewald, CE
R. B. Hatch, CE

Department of the Interior
G. E. Van Santen, BR
G. V. Schirk, BR
(Alt.) R. J. Coffman, BLM

Federal Power Commission
Gordon N. Boyer

State of Idaho
R. R. Lee, IWRB

State of Montana
John E. Acord, MWRB

State of Oregon
Fred D. Gustafson, OWRB

State of Washington
Ed Hammersmith,
Department of Ecology

State of Wyoming
Floyd A. Bishop, State Engineer

SUBREGIONAL PLAN FORMULATION TASK FORCES

Task Force A, Subregion 1

John E. Acord, Chairman
MWRB, State of Montana

Alan C. Robertson, IWRB
State of Idaho

Dennis Lundblad, Dept. of
Ecology, State of Washington

Herbert Young, Vice Chairman
CE, Department of the Army

John Isaacson
SCS, Department of Agriculture

B. E. Manderscheid
BR, Department of the Interior

Task Force B, Subregions 2, 3, 8, 10N, 11

Ed Hammersmith, Chairman
Department of Ecology
State of Washington

Frank Urabeck
CE, Department of the Army

B. E. Manderscheid, Vice Chairman
BR, Department of the Interior

John A. Isaacson
SCS, Department of Agriculture

Task Forces C and D, Subregions 4, 5, and 6

Wayne T. Haas, Chairman
IWRB, State of Idaho

Jack G. Johnson
OWRB, State of Oregon

Floyd A. Bishop
State Engineer's Office

Daniel F. Lawrence
Division of Water Resources
State of Utah

E. L. Michalson
Water Resources Research Inst.
University of Idaho

Glenn H. Masters, Vice Chairman "C"
BR, Department of the Interior

David R. Wagoner, Vice Chairman "D"
SCS, Department of Agriculture

Gary McMichael
CE, Department of the Army

David N. Gangwer
BR, Department of the Interior

Dennis Lundblad
Department of Ecology
State of Washington

Task Forces E and F, Subregions 7, 9, 10S, and 12

Jack G. Johnson, Chairman
OWRB, State of Oregon

D. E. Plaisance
BR, Department of the Interior

Herbert E. Carnahan, Vice Chairman "E"
SCS, Department of Agriculture

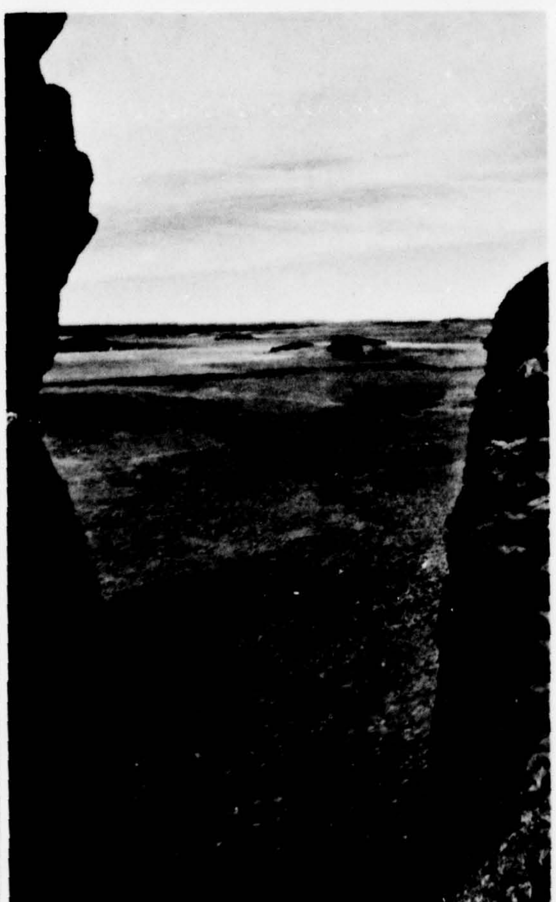
Kenneth J. Johnson, Vice Chairman "F"
CE, Department of the Army

This appendix to the Columbia-North Pacific Region Framework Report was prepared at field level under the auspices of the Pacific Northwest River Basins Commission. It is subject to review by the interested Federal agencies at the departmental level, by the Governors of the affected States, and by the Water Resources Council prior to its transmittal to the President of the United States for his review and ultimate transmittal to the Congress for its consideration.

Photography Credits

Ocean Scene	-	Oregon State Highway Department
Forest Scene	-	Forest Service
Desert Scene	-	Oregon State Highway Department
Mountain Scene	-	Idaho Department of Commerce & Development






CONTENTS

APPENDIX XVI
COMPREHENSIVE FRAMEWORK PLANS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

Page No.

LIST OF TABLES

LIST OF TABLES

LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES

INTRODUCTION

The framework plans and programs outlined in this appendix are presented, not as the final word of some governing body, but as a compendium of measures which, after examination and critical discussion, have been thought by the study participants to contribute to a balanced use of water and related land resources. These measures were arrived at on the basis of the best information available. Often the best information was incomplete, requiring a feel for practicability and feasibility that comes with long experience in given fields. Although some details of the plan will become partly obsolete in a short time, its overall pattern will remain for many years an excellent guide to regional possibilities and opportunities.

The plans may be taken as a starting point whenever resource protection or development comes under consideration. New alternatives should be compared against alternatives presented in this study. There should be no hesitation in studying measures earlier than the time period in which they are shown. Changing conditions and better information may warrant additions and modifications to the plans, shifts in the timing of implementation, and deletions.

By continuing refining and updating, the framework plans and programs should assist in meeting the water and related land needs of the future.

PURPOSE AND SCOPE

The study is a joint effort of Pacific Northwest States and Federal agencies undertaken for the purpose of providing a guide for more detailed planning leading to the best management, use, development, and conservation of water and related land resources.

A broad-scaled analysis of water and related land resource problems and needs has been made. The probable nature, extent, cost, and timing of alternative measures to solve problems or to meet needs were appraised. Framework plans and programs were formulated for three time periods--1970-1980, 1980-2000, and 2000-2020--using general relations, reasoned approximations, available data, and judgment of experienced planners, and they were formulated after public meetings in nearly all of the various states. A program for implementation of these measures was proposed. Individual project studies have not been undertaken, nor have inventories of all potential developments been compiled.

RELATIONSHIP TO OTHER APPENDICES

This appendix represents the focal point for accumulation, analysis, and presentation of comparative physical and economic data. The other appendices provide more detailed inventories of available resources and their present use, show the projected use and needs, and identify means to satisfy these needs. From these has been extracted the information needed for developing the framework plan.

NATIONAL OBJECTIVES OF PLANNING

Most development and management of the Nation's water and related land resources have been done in a rather fragmented fashion. The result has been a lack of adequate consideration for the interrelationships among all the alternative uses of our resources. As more demands were placed on our natural resources, it became evident that there were significant choices to be made between alternatives to insure balanced use. The result has been the emergency of areawide planning that takes into consideration all types of uses.

Senate Document 97[1/], which provided the basic national guidelines for water and related land resource planning when the study was made, states that the basic objective of water resource planning "is to provide the best use, or combination of uses, of water and related land resources to meet all foreseeable short- and long-term needs." In pursuing this objective, full consideration shall be given to three major objectives: (1) development, (2) preservation, and (3) well-being of people. Where conflicts occur, "reasoned choices" must be made between the objectives.

Development

National economic development and development of each region within the country are essential to the maintenance of national economic strength and the achievement of satisfactory levels of living. Water and related land resources development and management contribute to economic development and growth, through concurrent provision for: (1) adequate supplies of water for domestic, municipal, agricultural, and industrial uses; (2) water quality facilities and controls; (3) water navigation facilities; (4) hydroelectric power; (5) flood control or

1/ Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources. 87th Congress, 2nd Session, May 1962.

prevention measures; (6) land stabilization and water conservation measures; (7) drainage measures, including salinity control; (8) watershed protection and management measures; (9) outdoor recreational opportunities; (10) maintenance and enhancement of fish and wildlife resources; and (11) any other means by which development of water and related land resources can contribute to economic growth and development.

Preservation

Proper stewardship in the long-term interest of the Nation's natural bounty requires in particular instances that: (1) there be protection and rehabilitation of resources to insure availability for their best use when needed; (2) open space, green space, and wild areas of rivers, lakes, beaches, mountains, and related land areas be maintained and used for recreational purposes; and (3) areas of unique natural beauty, historical and scientific interest be preserved and managed primarily for the inspiration, enjoyment, and education of the people.

Well-Being of People

Well-being of all the people shall be the overriding determinant in considering the best use of water and related land resources. Hardship and basic needs of particular groups within the general public shall be of concern, but care shall be taken to avoid resource use and development for the benefit of a few or the disadvantage of many. In particular, policy requirements and guides established by the Congress are aimed at assuring that the use of natural resources shall safeguard the interests of all of our people.

STUDY OBJECTIVES

The Columbia-North Pacific Framework Study has been conducted to meet the three broad objectives of economic efficiency, regional development, and environmental quality. These planning objectives, adopted by the River Basins Commission in 1968, are nearly parallel to the objectives described in the Water Resources Council's proposed, "Principles and Standards for Planning Water & Related Land Resources" (Federal Register, vol. 36, No. 245, Part II). Other objectives which have been considered are: acceptability, income redistribution, political equity, and population and industry distribution.

Economic Efficiency

The economic efficiency objective is the maximization of social and economic returns to the Nation per unit of investment in water and related land resources. Framework plans for the Columbia-North Pacific Study under this objective are based on the national projections developed by the Office of Business Economics, Department of Commerce, and the Economic Research Service, Department of Agriculture (OBERS), under sponsorship of the Water Resources Council. Inasmuch as the projections are based primarily on past trends, they reflect the pattern of national economic efficiency as it has developed under our system of enterprise and government.

Regional Development

The regional development objective is the attainment of a desired pattern of regional income or development through water and related land resources investments. Examples of this objective are: increased personal income; increased total output; and enhancement of the economic integrity of an area. The objective reflects desired regional social and economic goals and State water resource plans. Planning analyses will indicate where available resources exceed projected needs for economic efficiency and where regional development can be achieved. In many cases, the economic efficiency objective is the same as or similar to regional development objectives.

Environmental Quality

The environmental quality objective is the maintenance or improvement of the region's environmental quality. It includes, in addition to preservation, and perhaps more importantly, positive measures to create an improved overall environment and aims to insure that the effects of water resource development on "human ecology," the relationships between man and his environment, are carefully defined and evaluated. The extent to which the environmental quality objective is attained cannot be readily measured in the same terms that might be used for the national efficiency and regional development objectives.

As the economic efficiency and regional development objectives include evaluation of needs for environmental factors such as water quality, recreation, fish and wildlife, etc., the environmental quality objective may be met, in part, by satisfying the first two objectives. However, in some instances available resources are not sufficient to meet both the development and environmental quality objectives.

PLANNING POLICIES, PROCEDURES, AND CONSTRAINTS

Federal Policy

Senate Document 97, 87th Congress, 2nd Session, establishes uniform policies and procedures for water and related land resources planning and prescribes interpretation by the Federal Departments and by the Office of Management and Budget of policies established by differing Federal legislation. The most recent expression of Federal policy is in Section 2 of the Water Resources Planning Act of 1965 (Public Law 89-90):

> "In order to meet the rapidly expanding demands for water throughout the Nation, it is hereby declared to be the policy of the Congress to encourage the conservation, development, and utilization of water and related land resources of the United States on a comprehensive and coordinated basis by the Federal Government, States, localities, and private enterprise with the cooperation of all affected Federal agencies, States, local government, individuals, corporations, business enterprises, and others concerned."

States' Policies

The states are responsible for establishing intrastate planning policy and coordinating state programs for water and related land resource planning. In addition, the states administer water rights and are responsible for most regulatory activities dealing with water such as stream channel alteration, water quality control, fishing, and recreation use. The states also exercise major influence on Federal water programs by expressing state viewpoints on proposed projects and programs within their boundaries.

In the Columbia-North Pacific Region, current water laws of all states except Washington are based essentially on the doctrine of prior appropriation and beneficial use. Washington water law is based on a dual system of the common law doctrine of riparian rights and the doctrine of prior appropriation.

Planning Concepts and Definitions

The following concepts and definitions are essential to an understanding of this appendix:

Framework Concept (Type 1 Studies). This is the type study covered by this document. It is a study of a region

coordinated by a river basin commission or other Federal interagency-State coordinating organization that provides economic projections of economic development, translation of such projections into demands for water and related land resource uses, hydrologic projections of water availability, both as to quantity and quality, and projections of related land resource availability, so as to outline the characteristics of projected water and related land resources problems and the general approaches that appear appropriate for their solution. Such framework studies would provide general guides to future water resource development. In addition to indicating which regions or subbasins have water problems calling for prompt detailed planning efforts as well as those where no such problems are current or looming, such studies will provide a substantial contribution of fact and analysis to subsequent detailed plan formulation.

Comprehensive Concept (Type 2 Studies). Studies of this type were made of the Willamette River Basin, Oregon, and Puget Sound & Adjacent Waters, Washington, the results of which were included in this document. They are more detailed studies of feasibility or survey scope for individual river basins, tributary basins, or subregions. They are used for areas with complex problems needing concerted multi-agency action for their solution. For areas not previously covered by Type 1 studies, they encompass the features of the Type 1 study, plus the refinements and details of the feasibility or survey scope study. In cases where the Type 2 study area has been covered by Type 1 studies, pertinent features of the latter are summarized as needed for continuation into feasibility or survey scope studies. Type 2 studies are coordinated by a river basin commission or other Federal interagency-State coordinating organization. Such studies define or evaluate projects and programs in sufficient detail to comprise a basis for authorization or implementation of those projects to be initiated in the next 10 or 15 years.

Related Land. The term "related land" as used in this study refers to land that is associated with water resources, or the effects of the water resources and their development features on the land. Only related land is involved directly in the formulation of framework plans. The study is not intended to include all resources and their uses. Neither does the study cover such items as transportation systems or urban areas and industrial developments.

Projections. As planning of water and related land resources is for the purpose of satisfying the future, the effort

hinges on projections of future growth. To insure uniformity between projections and to relate all projections to the Nation as a whole, the Water Resources Council developed a national-interregional projections programs which provided projections of population, income, employment, and the demand for agricultural and forestry goods and service both for the United States and for each region. Framework planning was based on these projections except for the Willamette and Puget Sound Subregions where independent projections were developed for Type 2 studies. These projections are summarized later in the text and in detail in Appendix VI, Economic Base & Projections.

These projected levels of population, economic activity, and agricultural productivity are only a representation of conditions that could exist in the future if past trends continued. They are indicators of potential problems and are not meant to be taken as goals or objective or an assumption that past occurrence will continue into the indefinite future. Rather, the projections are used to formulate framework plans and alternatives as a baseline for further resource planning, protection, or development.

Criteria

General criteria for the management and development of water and related land resources in Senate Document 97 have been described previously. Other criteria used in formulating plans and alternatives were:

(1) The study objectives of economic efficiency, regional development, and environmental quality are of equal importance in the formulation of plans.

(2) Framework studies are concerned only with the intra-regional water and related land resources and their uses except that, where natural interregional hydrologic connections are involved, the interregional aspects may be considered. In the Columbia-North Pacific Study, this applies only to waters flowing between Canada and the United States.

(3) Alternatives considered in the formulation of framework plans include means, within practical limits, for meeting water and related land needs, either singly or in combinations. Alternatives presented in the report are concerned primarily with significant alternative uses of resources or major alternative means of satisfying needs, not primarily with alternative engineering plans for accomplishing the same purposes.

(4) Framework plans are in conformance with existing Federal and State laws, treaties, and compacts, wherever practicable. Where the proposed plan or program varies from existing law, the variations are indicated and the extent of the changes in law or policy required for the most optimum development delineated.

(5) Framework studies relate the availability of water and related land resources to projected 1980, 2000, and 2020 needs, and assess the potential for development and management of the resources to meet the projected needs.

(6) Framework studies reach conclusions as to the urgency of water and related land problems and the detailed studies leading to a program for the development and management of the water and related land resources.

(7) Generally, information used in plan formulation is supported by other appendixes. However, omission of data from technical appendixes did not preclude the consideration of additional or updated information in the planning process.

(8) Framework plans do not include elements unless they are related to water resources. Other facilities and programs are included as associated elements.

(9) Elements of framework plans are not subjected to economic analysis. Therefore, water development features and alternative plans are neither selected nor sized on the basis of economic benefits. They were chosen to meet projected needs using general relations, reasoned approximations, available data, and the judgment of experienced planners.

(10) Cost estimates for broad components of the framework plan are approximations. Federal and non-Federal funding are estimated. Costs include total installation costs and related nonstructural program costs. Operation, maintenance, and replacement costs relate to the end of the time frame period and only those installation costs incurred during that particular time frame.

(11) Major functional criteria:

<u>Natural Environment</u>	The preservation and enhancement of the natural environment should be considered equally with other water and land resource functions. Consideration should be given to management and control of coastal zone and estuaries; streambanks, landscapes, wetlands, logging, mining,

urban land and water use; maintenance of streams and water bodies in natural state; and the preservation of unique, historic, and scenic areas.

Flood Control	Nonstructural alternatives, zoning regulations, flood proofing of individual structures, and other nonstructural management practices should be considered alone and in combination with structural measures. Structural measures in urban locations, as an ultimate objective, should provide protection against a Standard Project Flood. As a minimum, 100-year protection should be provided to these areas, and floods that exceed the protection should not pose an undue threat to human life. Agricultural and rural land may be protected to a lesser degree but should have 25-year protection for areas in which homes are located.
Land Measures and Watershed Protection	Planned land use should be within its capabilities. Erosion control measures should provide protection of lands so that soil losses would not exceed 5 tons per acre per year or about 3 acre-inches per acre per 100 years. The degree of drainage should be at a level that would provide for the planned use of the land.
Irrigation	Physical considerations being equal within a general area, water should be supplied to presently irrigated areas having inadequate supplies prior to development of new land areas. In the absence of detailed studies, irrigation shortages, based on diversion requirements, should be limited to a maximum shortage of 50 percent in any year, a consecutive 2-year accumulated shortage of not to exceed 75 percent of the annual requirement, and an accumulated shortage of not to exceed 100 percent in any 10-year period.

Navigation — Needed improvements should be expressed in broad general terms such as number of ports, miles of channels, etc. required to move commerce. Flow requirements should be included.

Municipal & Industrial Water Supply — Municipal and industrial water supply should be provided without shortage whenever possible.

Water Quality & Pollution Control — The existing water quality standards established by the individual states are the basic criteria used in the plan formulation process. With the exception of the Puget Sound Subregion all municipal and industrial wastes would be subject to treatment resulting in removal of oxygen-demanding wastes of 85 percent by 1980, and 90 percent by 2000 and 2020. Based on current standards, discharge into certain marine waters of the Puget Sound may require only primary treatment. Where future studies indicate that these standards would not insure adequate water quality, higher levels of waste treatment would be specified. Minimum flow requirements compatible with these levels of waste treatment would be proposed to insure water quality suitable for withdrawal and instream uses.

Recreation — Recreational opportunities should be preserved and enhanced to extent possible. Wherever practicable, flood plains and unstable areas should be reserved for open space uses.

Fish & Wildlife — Existing fish and wildlife habitat would be preserved and enhanced to the maximum extent possible and adequate minimum streamflows specified.

Electric Power — All future power needs would be met. Planning would be done on a regional basis. Hydroelectric power capability should be determined on the most adverse sequence of historical flows. Direct cooling for thermal

plants would not be acceptable, except for limited salt water cooling and for special circumstances where the cooling water would not be returned directly to the waterway.

Procedures

Study Areas

For study purposes, the Columbia-North Pacific Region was divided into 12 subregions. These subregions were consolidated into four broad hydrologic-political areas for development of the regional plan (figure 1). Selection of subregional boundaries was based on hydrologic divisions that were usable for most water planning functions. As data used in the economic base studies and projections were available only by counties, economic subregion boundaries are along county lines, following as near as possible the hydrologic boundaries.

Methodology for Formulation of Framework Plan

The methodology used in formulating the framework plan is summarized in the following seven steps:

(1) An inventory of existing water and related land resources. A complete inventory is compiled in Appendices IV and V.

(2) Projected gross needs by target dates 1980, 2000, and 2020. These were developed for each water and related land resource function using the economic projections developed in Appendix VI and in Type 2 studies of Subregions 9 and 11. These needs appear in Appendices VII-XV. Functional needs are expressed quantitatively while social needs are mostly in qualitative terms. Water requirements are expressed as consumptive or nonconsumptive for key locations and specified target dates.

(3) An inventory of existing and assured projects and programs and determination of residual needs. The capability for meeting current and projected needs and requirements was evaluated. Residual or net needs for target dates 1980, 2000, and 2020 were found by reducing gross needs by these capabilities.

(4) Development of means to satisfy needs. Plans were formulated to satisfy a particular functional need with minimal regard to the impact of other resource users. This was done in

order to obtain the maximum possible array of alternatives. The results of these studies are given in Appendices VII through XV.

(5) Formulation of alternatives for meeting residual needs. Alternative plans were confined largely to significant alternative uses of resources or means of satisfying needs. Economic efficiency, regional development, and environmental quality objectives relate mainly to alternative resource uses or alternative time scales in the case of regional development. Where a single plan could not meet all objectives simultaneously, alternatives were developed that reflect the trade-offs involved so that a rational choice could be made.

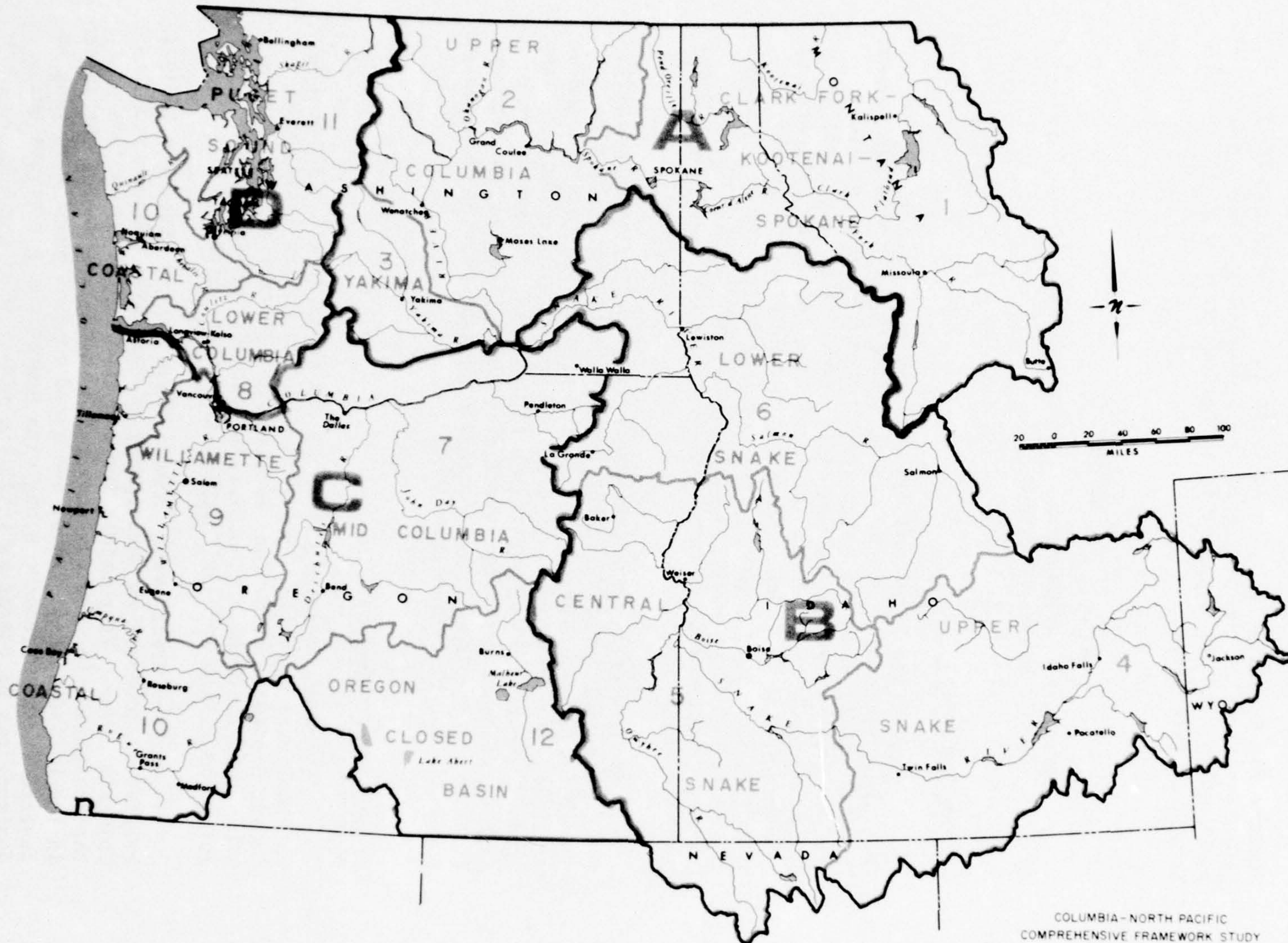
(6) Evaluation of alternatives to arrive at the framework plan. The framework plan selected was intended to best meet existing and projected needs and objectives, taking into account public views, acceptability, equity, etc. Where clear-cut choices could not be made, the alternatives were presented and further studies recommended. Needs that could not be met were identified.

(7) Implementation of plans and programs. A program of implementation was included to guide the sequence of development, to summarize required legislation, and to set forth the nature and extent of further studies.

Coordination for the Columbia-North Pacific Study occurred at several levels, both on an intermittent and a continuous basis. Overall policy coordination was exercised by the Pacific Northwest River Basins Commission. Administration and policy coordination, as well as coordination of review in the states and Federal agencies, was effected by the liaison representatives. A technical staff, composed of representatives from the Departments of Agriculture, Army, and Interior, chaired by a Commission employee, was responsible for day-to-day direction of study content, scope, and coordination between work groups and task forces. In addition, this staff provided guidance on format, illustrations, and printing, handled the review by agencies, prepared three appendices and the Main Report, as well as providing leadership in the plan formulation effort.

Framework plans for the 12 subregions in the study area were developed by the six task forces described in the section on "Coordination and Administration." Each of these task forces was chaired by a state representative, with planning assistance by task force members and backup personnel from several Federal and State agencies.

Overall guidance to the six plan formulation task forces was given by a Regional Plan Formulation Task Force. This group assisted in developing regional plans and preparing the Regional



COLUMBIA - NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

PLAN FORMULATION AREAS

THE REGION

1968

FIGURE 1

Summary for Appendix XVI. In addition to the Technical Staff, representatives of the States of Idaho, Montana, Oregon, Washington, and Wyoming, and the Departments of Agriculture, Army and Interior served on this group.

Constraints

Constraints arise primarily from existing laws and policies at both Federal and State levels.

Stream Management

Many of the State and Federal laws and policies impose restraints on water resource planning involving stream management. Important among them are basic state water laws dealing with appropriations, recognized beneficial uses, withdrawal, quality, diversion, and also Federal and local laws involving repayment of construction costs. Some others are preservation of scenic, historic, and other areas of state or national interest. Examples of the latter are the Oregon State Scenic Waterways Act, the Historic Preservation Act, P.L. 89-665, and the State and Federal Antiquity Acts.

Among present arrangements for regional water management, the constraints embodied in the Flood Control Operating Plan for the Columbia River Treaty Storage are probably the most extensive, affecting all major reservoirs of the Columbia River Basin. They include maintenance of sufficient flows to satisfy prior water rights, adequate flow for normal fish populations and anadromous fish runs, adjustments to accommodate navigation, and releases for power and for pollution abatement.

Treaties and Compacts

Important constraints on stream management are imposed by international treaties. The 1910 Boundary Waters Treaty with Canada provides navigation restrictions; control of use, diversions, and obstructions; pollution control; and an International Joint Commission for jurisdiction over these matters.

Another treaty with Canada, which became effective in 1964, relates to cooperative development of the water resources of the Columbia River. It provides for construction of three dams on the Columbia River and tributaries in Canada and one on the Kootenai in the United States. Power and flood control benefit sharing is covered in the agreement along with provisions for diversions, designations of operating entities, etc.

The United States Government is trustee for all Indian natural resources including land and water in the Columbia-North Pacific Area under study. The Indian natural resources are private property held in trust for the Indian. All Federal, State, and local agencies and other planning groups should be aware that the prior immemorial rights of the Indian (land, water, fishery) must be recognized and the Indian tribes should be a part of any future comprehensive planning. The Bureau of Indian Affairs is exploring ways and means, including funds, to inventory all Indian natural resources to insure that the unique character of these Indian rights is recognized and protected and preserved. Any action by any planning group--Federal, State, or local--must be in contemplation of the unique and distinct Indian interest. These interests must not be confused with public rights or interests which could impair and invade the Indians' rights. These treaties relating to fishing rights and use of water on Indian Reservations affect the use of waterways and water.

A state compact relating to management of Snake River waters exists between Idaho and Wyoming.

Further details on these treaties and compacts are given in Appendix III, Legal & Administrative Background.

Electric Power Agreements

Some Federal Power Commission licenses include provisions limiting flows or changes in water stage below specified powerplants. The Pacific Northwest Coordination Agreement is a formal contract for coordinating the seasonal operation of the generating resources of the member systems for the best utilization of their collective reservoir storage. Finalized in 1964, the Agreement will run through 2003. The Agreement has been ratified by 16 agencies and utilities, which provide most of the generation of the Columbia River System. All entities that have entered into this Agreement have done so on a voluntary basis.

Administrative Controls

Planning efforts in themselves are affected by existing legal and administrative constraints. For instance, the Water Resources Council Guidelines for Framework Studies prescribe:

> "Framework studies will be concerned only with the intraregional water and related land resources and their uses except that where natural interregional hydrologic connections are involved. . . , the interregional aspects may be considered. . . ."

The Water Resources Council memorandum regarding wild and scenic river consideration in Framework Studies prescribes that:

> "Wild and Scenic Rivers in the National System will be considered as in place and operation in the same manner as active authorized or constructed water resource projects. Proposals or recommendations for water resource project development and use in designated wild, scenic, and recreational rivers and reaches must recognize the requirements of Sec. 7(a) of the Wild & Scenic Rivers Act. . . ."

Also it prescribes that:

> "Where wild and scenic river studies are not underway or completed, retention of these rivers in their free-flowing condition for wild, scenic, and recreational use and the management of these rivers and adjacent lands for such purposes as a possible appropriate alternative use shall be studied, considered, and discussed as required by Section 5(d) of the Act. However, detailed site studies are not to be made as part of the Type 1 studies."

Others

The major constraint in the study is the requirement to use available data. Other constraints involved in framework planning are the limited and fragmented political jurisdictions which must be considered and the limited, overlapping, or divided authority of agencies at the Federal, State, and local level.

Assumptions

As previously mentioned, this study is based on national projections developed under the sponsorship of Water Resources Council, Washington, D.C., and special economic investigations in subregions covered by Type 2 studies. Explicit assumptions controlling these projections were:

(1) Sufficient quantities of water of acceptable quality will be available by timely development to avoid being a constraint to economic growth.

(2) The Federal Government, as a matter of national policy, will actively support programs designed to stimulate economic growth.

(3) There will be no general war or any appreciable cessation of cold war throughout the period to 1980. Expenditures on national security will continue to account for approximately 10 percent of gross national product.

(4) There will be a continued relaxation of trade, tariffs, and quotas accompanied by an expansion in international commerce.

DESCRIPTION OF THE REGION

DESCRIPTION OF THE REGION

The Columbia-North Pacific Region occupies the northwestern corner of the conterminous United States (figure 1). The total area of about 274,400 square miles includes all of Washington, most of Oregon and Idaho, western Montana, and parts of Wyoming, Utah, and Nevada. It includes all of the Columbia River Drainage in the United States, the river basins of Oregon and Washington draining into the Pacific Ocean, Puget Sound, the Strait of Juan de Fuca, the Strait of Georgia, and the closed basin of southeast Oregon. Part of the Columbia River and Puget Sound drainages lie in Canada and are not included in the study area. A complete description of the region is in Appendix II, The Region.

The Pacific Northwest is endowed with a wealth of interest-creating diversity in natural surroundings. Immense green valleys, majestic forests, barren deserts, and rugged coastlines form a complex interwoven landscape.

The three major mountain ranges, the Coast Range, the Cascade Range, and the Rocky Mountains exhibit many diverse physical features. The peaks of the Coast Range, few of which extend above 3,000 feet, have thickly vegetated slopes with timber and underbrush dominating. Inland and running parallel to the Coast Range, the Cascades are dominately a volcanic range with several peaks over 10,000 feet, the flanks of which are covered by dense stands of timber. The Rocky Mountains are among the most impressive in the world; few peaks are over 12,000 feet but the landscape of Idaho and western Montana is dominated by these mountains. Vegetative cover depends on elevation, grass on the lower slopes transcends into trees which fade into bare rocks at timberline.

Between the Coast and Cascades lies the most extensive lowland section of the region, the Willamette-Puget Sound Trough. Although densely populated, much forest, brush, and grassland remain.

Most of eastern Oregon and Washington, and southern Idaho, are contained in a large upland which is commonly called the Columbia Plateau. The plateau is divided into several sections and subsections but, in general, exhibits similar geological and vegetative features. The surface is almost entirely of volcanic origin and is covered with dryland plants such as sagebrush, grass, and juniper.

The climate is associated with the southerly and easterly drift of cyclonic storms that develop in the northern Pacific Ocean, and with the seasonal migration of the semipermanent high pressure and anticyclonic area of the Central Pacific. During the winter months, cyclonic storms pass over the region bringing generally wet conditions. During the summer, the cyclonic storms pass generally to the north of the region and dry conditions prevail.

Precipitation ranges from over 240 inches in the Olympic Mountains of western Washington to under 10 inches in many parts of eastern Oregon and Washington. Annual rainfall over the bulk of the region, however, averages between 15 and 40 inches. Seasonal and areal variation in average precipitation is shown below with rainfall data for Seattle (a coast station), and Boise (an interior station).

	January	July	Annual
Seattle	5.2"	0.6"	34.1"
Boise	1.3"	0.2"	11.4"

The general eastward movement of air masses usually keeps temperatures moderate. Occasionally, continental high pressure areas reverse the flow sending dry air westward--hot in summer and cold in winter, causing extremes of temperature. The recorded extremes have been from a high of 119°F. at Prineville, Oregon, to a low of -70° at Rogers Pass, Montana. Temperatures at Seattle, Washington, and Boise, Idaho average:

	January	July	Annual
Seattle	41.2°F.	65.6°F.	53.2°F.
Boise	29.1°F.	75.2°F.	51.0°F.

The frost-free season typifies the generally moderate climate with 60 percent of the region having a frost-free season of from 80 to 160 days a year. The range of frost-free days, however, is from over 240 days along the Pacific Coast to under 40 days along some areas of the Continental Divide in eastern Idaho. More detailed climatic data are presented in Appendix V, Water Resources.

The streams of the region have relatively seasonal flows with a low period in the summer months and a high period during the winter or late spring-early summer months. The coastal and Puget Sound streams generally peak in the winter as a result of heavy rainfall. The Columbia River, which drains 259,000 square miles and discharges an average of 175.7 million acre-feet annually, usually experiences high flows in late spring and early summer. Some of the major streams of the Pacific Northwest and their average annual discharge are shown in table 1.

Table 1 - Annual Discharge of Major Streams, Columbia-North Pacific Region

Stream	Location	Acre-Feet
Columbia	Mouth	173,500,000
Snake	Ice Harbor Dam	33,300,000
Willamette	Oregon City	21,600,000
Kootenai	Porthill	11,100,000
Pend Oreille	Z Canyon	18,700,000
Skagit	Concrete	10,300,000
Snohomish	Mouth	7,100,000
Rogue	Mouth	8,200,000
Umpqua	Elkton	5,300,000
Chehalis	Grand Mound	2,000,000
Puyallup	Puyallup	2,400,000

Ground water can be obtained at practically any place, but quantities obtainable from a well range from a very few to several thousands of gallons per minute. Over 40 percent of the region is underlain by aquifer units that yield only small supplies.

In 1970, the population of the region was about 6,373,600. Density varied from 144 persons per square mile in the Puget Sound Subregion to 0.8 persons per square mile in the Oregon Closed Basin. As shown in the Addendum to Appendix VI, Economic Base & Projections, the population is projected to increase to 15,395,000 by 2020. Puget and Willamette Subregions will continue to contain by far the largest proportion of the population in 2020 with the Closed Basin of Oregon containing the least. At that time, 75 percent of the region's people are expected to be living in the area west of the Cascade Range on 20 percent of the region's land.

The major industries are: agriculture and food processing, lumbering and forest products, recreation, minerals, metals, chemicals, and manufacturing. The two most important industries in terms of number of persons employed and economic effect are agricultural and forest products. In 1965, the forest industry employed nearly 166,000 people or over one-third of the total manufacturing force. This figure is not expected to increase substantially in the future. In 1960, total employment in the region was about 2 million; this figure is projected to increase to about 5.2 million by 2020, an increase of over 250 percent.

There are seven standard metropolitan statistical areas in the Pacific Northwest. In 1970, their populations were:

Seattle	1,421,869
Portland	1,009,129
Tacoma	411,027
Spokane	287,487
Eugene	213,358
Salem	186,658
Boise	112,230

RESOURCE AVAILABILITY

RESOURCE AVAILABILITY

The Columbia-North Pacific Region contains high quality water and land resources, as well as some minerals in sufficient quantities to be of economic importance.

There are some limitations in the use of these resources, the principal one being their distribution. Although water is abundant on an annual basis, most precipitation falls in the winter, resulting in a deficiency during the summer months, especially in the central and eastern parts. Other limiting factors include economic, political, and social considerations.

Land and water resource data, summarized from other appendices, are shown in table 2.

Table 2 - Summary of Water and Land Resources, 1970
Columbia-North Pacific Region

	Water				Ground Water4/		Land		
Subregion	Surface Area3/ 1,000 ac	Mean Annual Inflow1/ cfs	Mean Annual Outflow1/ cfs	Storage Volume2/ 1,000 ac-ft	Volume 1,000 ac-ft	Recharge 1,000 ac-ft	Surface Area3/ 1,000 ac	Arable5/ 1,000 ac	Irrigable6/ 1,000 ac
1	452	12,305	48,558	11,479	69,000	19,000	22,819	5,055	2,990
2	288	109,500	114,100	7,578	35,000	6,000	14,081	4,790	3,701
3	29	0	3,240	1,071	13,000	2,000	3,851	1,463	1,137
4	266	0	8,590	5,417	100,000	18,000	22,682	7,027	6,948
5	170	8,590	16,338	4,599	100,000	5,000	23,398	6,668	6,521
6	81	16,338	45,984	1,631	31,000	9,000	22,371	4,458	3,667
7	126	163,531	177,400	1,814	47,000	12,000	18,822	8,187	6,267
8	73	210,437	235,408	2,201	8,000	6,300	3,193	1,130	577
9	106	0	38,490	2,017	27,000	11,000	7,603	2,802	1,747
10	155	0	87,615	169	27,000	16,000	15,054	3,567	1,705
11	100	977	53,090	2,426	40,000	11,000	8,447	2,067	1,611
12	63	0	1,650	17	56,000	800	11,395	3,850	3,261
Region	1,909	74,230	384,008	40,419	553,000	116,100	173,716	51,064	40,232

1/ From Appendix V, Water Resources.
2/ Reservoirs over 5,000 acre-feet only active capacity shown, source Appendix V, Water Resources.
3/ From Appendix IV, Land and Water Areas tables (rounded).
4/ Gross values from storage, recharge, and discharge of ground water in aquifer units, Appendix V.
5/ Sum of Land Capability Class I through IV and Class VI suitable for crops.
6/ Dry irrigable and irrigated land, Appendix IX (includes land presently irrigated).

SURFACE WATER

Quantity

The Columbia River, one of the major streams in the world, is the dominant feature in the drainage system of the Columbia-North Pacific Region. All the major streams of the region, except those in the Coastal and Puget Sound areas, drain into the Columbia River. Its drainage system includes approximately 80 percent of the total area and discharges about 55 percent of the average annual runoff. Subregions 10 and 11, the Puget Sound and Coastal Subregions, include 13.5 percent of the region's area but contribute

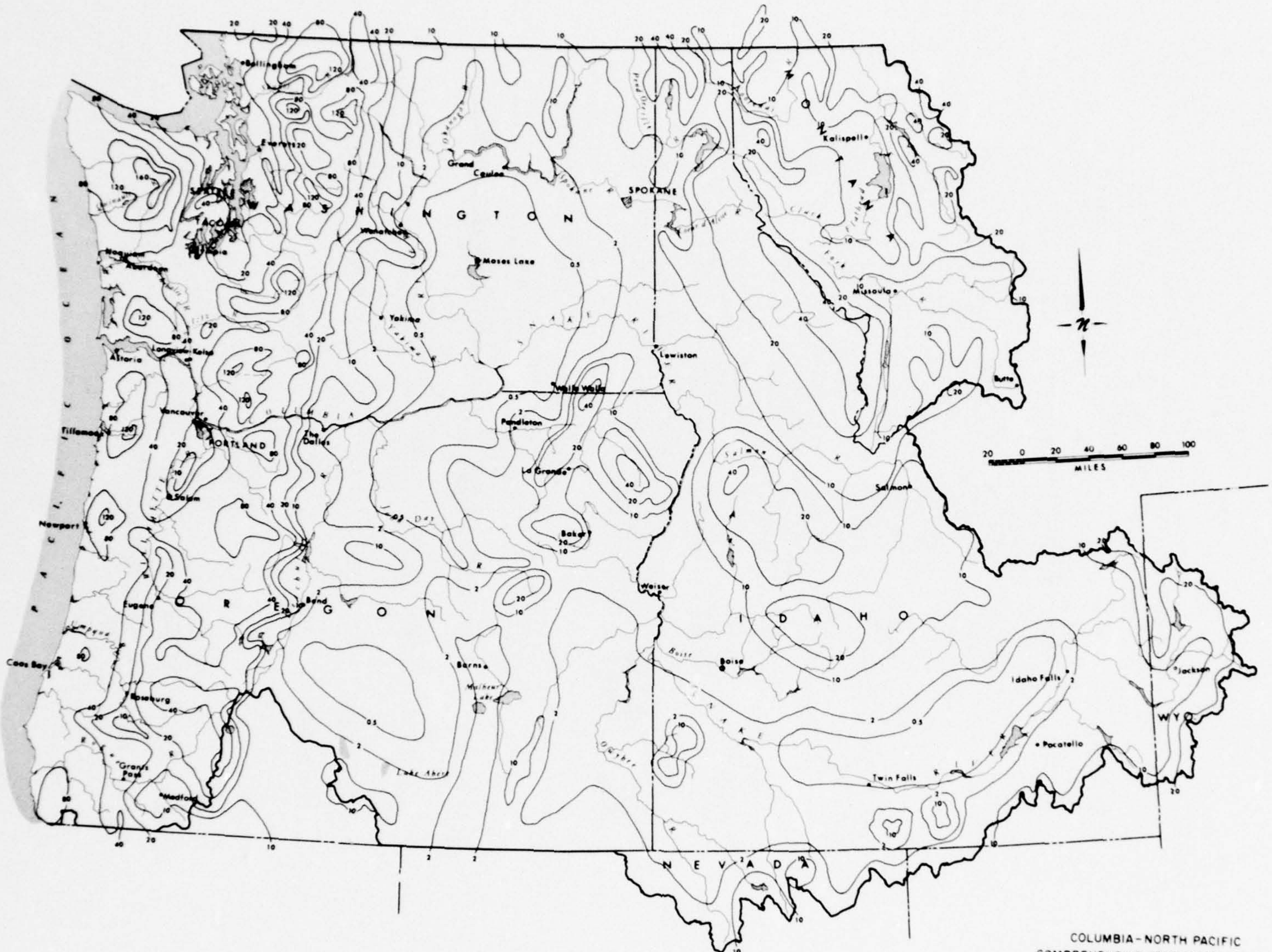
45 percent of the water discharged. Subregion 12, a closed basin, constitutes 6.5 percent of the region's area but contributes less than 1 percent of its water. It is the only part of the region without an outlet to the ocean.

Discharges of the region's principal streams and differences in mean annual runoff are summarized for selected sites in table 3. The average discharge and the approximate flows that would be available 80, 90, and 95 percent of the time for the base period 1929-58 and reflecting 1970 levels of utilization are shown in table 4. The discharge for a subregion represents the flow originating in that subregion or outflow minus inflow. Inflow from Canada is added to complete the water-availability picture. Table 5 provides a breakdown of the regional discharge shown in table 4 to show the quantity of water contributed by each of the seven states concerned.

Table 3 - Streamflow Summary for Selected Sites
Columbia-North Pacific Region

Subregion	Stream	Station	Drainage Area (sq.mi.)	Annual Flow1/ Mean	Max.	80% Flow	Min.	Momentary Flow2/ Max.	Min.
					(cfs)			(cfs)	
1	Kootenai	Porthill	13,700	15,328	22,143	10,722	9,926	125,000	1,380
1	Pend Oreille	Z-Canyon	25,200	25,839	37,624	17,902	14,861	171,300	2,500
1	Spokane	Spokane	4,290	6,485	10,353	3,923	2,970	49,000	95
1	Clark Fork	Plains	19,958	18,328	26,253	12,697	9,954	134,010	3,200
2	Columbia	Priest Rapids	96,000	114,100	159,000	89,900	86,600	692,600	4,120
2	Okanogan	Tonasket	7,280	2,894	4,588	1,785	1,241	40,900	126
2	Wenatchee	Peshatin	1,000	3,010	5,386	1,888	1,729	32,300	183
3	Yakima	Kiona	5,615	3,240	6,843	1,766	1,540	67,000	105
4	Snake	King Hill	35,800	8,590	11,999	7,044	6,909	47,200	1,250
4	Henrys Fork	Rexburg	2,920	1,512	2,387	1,034	798	11,000	183
5	Snake	Oxbow	73,150	16,338	26,037	12,349	11,124	76,800	441
5	Boise	Notus	3,820	960	2,325	410	289	20,500	10
5	Payette	Payette	3,240	2,707	4,521	3,722	1,430	30,900	180
6	Snake	Ice Harbor Dam	108,500	45,984	66,398	35,220	31,029	298,000	11,800
6	Salmon	Whitebird	13,550	10,690	15,891	7,563	5,792	106,000	1,580
6	Clearwater	Spalding	9,570	14,573	22,447	10,599	9,826	177,000	500
7	John Day	McDonald Ferry	7,580	1,925	3,669	982	630	42,800	4
7	Deschutes	Moody	10,500	5,186	7,340	4,097	3,940	75,500	2,400
7	Columbia	Bonneville	240,000	177,400	247,346	142,517	131,353	1,240,000	35,000
8	Lewis	Ariel	731	4,752	7,069	2,298	3,090	129,000	1
8	Cowlitz	Castle Rock	2,238	8,932	12,484	5,893	5,776	139,000	998
8	Columbia	Mouth	259,000	239,671	388,362	185,228	165,611		
9	McKenzie	Coburg	1,337	5,508	8,242	3,361	3,170	88,200	1,250
9	Santiam	Jefferson	1,790	7,596	11,722	4,441	4,656	197,000	260
9	Willamette	Oregon City	10,008	29,900	43,694	16,480	17,660		
10	Rogue	Gold Beach	5,060	11,290	21,150	5,252	4,621		
10	Umpqua	Elkton	3,683	7,353	13,350	3,925	3,150	256,000	640
10	Chehalis	Grand Mound	895	2,761	4,444	1,540	1,569	48,400	90
10	Quinalt	Quinalt Lake	264	2,766	3,571	1,842	1,780	50,200	276
11	Puyallup	Puyallup	948	3,292	4,927	2,356	2,087	57,000	400
11	Snoqualmie	Carnation	603	3,714	5,190	2,410	2,314	59,500	239
11	Sauk	Sauk	714	4,241	5,923	2,950	2,887	82,400	572
11	Skagit	Concrete	2,737	14,224	20,003	10,421	9,507	500,000	2,160
12	Chewaucan	Paisley	275	139	341	32	32	6,490	0
12	Silvies	Burns	934	164	375	44	15	4,960	0

1/ Regulated values for base period (1929-1958) 1970 conditions.
2/ Observed values for period of record.
Source: Appendix V, Water Resources.



COLUMBIA-NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

MEAN ANNUAL RUNOFF IN INCHES

THE REGION

1968

FIGURE 2

Table 4 - Annual Discharge, 1970 Conditions, Base Period 1929-58
Columbia-North Pacific Region

Subregion	Drainage Area (sq mi)	Average Discharge (cfs)	Discharge Available: Percent of Time Flow Exceeded 80 (cfs)	90 (cfs)	95 (cfs)
1	36,361	36,253	25,985	22,000	19,500
2	22,451	5,300	-1,800[1/]	-6,000[1/]	-8,700[1/]
3	6,062	3,240	1,776	1,400	1,200
4	35,857	8,590	7,044	6,700	6,600
5	36,825	7,748	4,856	3,100	2,500
6	35,081	29,939	22,968	16,700	15,200
7	29,606	13,869	11,469	7,100	5,900
8	5,103	24,971	16,988	15,100	14,200
9	12,046	38,490	21,869	17,200	15,000
10	23,763	87,615	57,813	46,500	39,000
11	13,355	52,113	40,864	36,100	33,400
12	17,904	1,650	670	400	300
Region (U.S.)	274,414	309,778	210,502	166,300	144,100
Canada	39,910	74,230	59,000	53,500	51,000
Total	314,324	384,008	269,502	219,800	195,100

1/ Minus figures are caused by diversions and storage operations that are greater than the discharge that originated in the subregion.
Source: Appendix V, Water Resources.

Table 5 - Average Discharge, by State, 1970 Conditions, Base Period 1929-58
Columbia-North Pacific Region

Subregion	Idaho	Montana	Nevada	Oregon (cfs)	Utah	Wash.	Wyoming	Total
1	11,328	22,350	-	-	-	2,575	-	36,253
2	-	-	-	-	-	5,300	-	5,300
3	-	-	-	-	-	3,240	-	3,240
4	1,843	-	138	-	28	-	6,581	8,590
5	5,761	-	772	1,215	-	-	-	7,748
6	26,300	-	-	3,400	-	239	-	29,939
7	-	-	-	9,260	-	4,609	-	13,869
8	-	-	-	-	-	24,971	-	24,971
9	-	-	-	38,490	-	-	-	38,490
10	-	-	-	52,919	-	34,696	-	87,615
11	-	-	-	-	-	52,113	-	52,113
12	-	-	-	1,650	-	-	-	1,650
Region	45,232	22,350	910	106,934	28	127,745	6,581	309,778

Source: Appendix V, Water Resources.

The total average discharge produced within the region under 1970 conditions was 310,000 cfs. About 66 percent of this originates west of the Cascade Range on about 20 percent of the region's area. In addition, Canada contributes about 74,000 cfs, making a total of 384,000 cfs or 278 million acre-feet annually.

In spite of the apparent large total supply, water is not always available where and when it is needed. Extreme variations occur in both the areal distribution and timing of runoff. Consequently, the average discharge is not the usable supply. Even with storage, the total mean discharge is not usable because of natural losses and seasonal as well as year-to-year variations. In most streams, the minimum year of discharge provided only about 60 percent of the average annual flow; also, the mean of the minimum 5 consecutive years supplied only about 75 percent of average. There are some large streams that produce minimum year flows as low as 25 percent of the long-term average.

Quality

Although the quality of surface waters is generally good for most uses, its use for domestic, industrial, and agricultural purposes has altered the biologic and chemical qualities. Most surface water supplies require treatment before being used for domestic purposes. Treatment is not required for irrigation or for most industrial uses.

At the present time, recreational, municipal, and industrial uses produce wastes equivalent to those from a population of 44.5 million persons. Treatment facilities reduce the waste discharge to the streams to 20 million population equivalents (p.e.). However this residual waste loading causes problems at some places in the region.

Watersheds

The major watersheds can be divided into the approximate groupings outlined in the description of the region. Factors of importance to the runoff volume and patterns of these areas include: cover type, elevation, rock types, and type and timing of precipitation.

Although most of the coastal area is forest covered, a factor which tends to retard the runoff, the underlying rocks are fairly impervious, allowing only a minimum percolation to take place. This factor, coupled with the fact that most of the precipitation falls as rain, leads to rapid runoff soon after precipitation occurs. Also because there is little ground-water storage, runoff decreases to low levels during the dry months.

The Willamette Valley-Puget Sound Trough has much the same characteristics as the Coast Range, except that the western slopes of the Cascade Range store a considerable amount of water in the porous volcanic rocks to somewhat sustain the summer flows.

At higher elevations in the Cascade Range, much of the precipitation falls as snow. These mountains are exposed to the moist ocean air so that heavy accumulations of snow are common. Periods of high runoff usually occur during the spring and early summer.

Glaciers are of particular importance to the maintenance of summer flows. About 83 percent of the conterminous United States glacier-covered area is in the region. Glacial runoff amounts to nearly 1.4 million acre-feet of water annually, two-thirds of which is released during the summer months.

The high plateau areas of central and eastern Oregon and Washington and of southern Idaho generally have winter snowfall and rain. The snow accumulates at higher elevations and usually melts during the spring producing the high runoff of the year. Summer thunder showers produce locally heavy runoff for short periods. As the vegetation is not dense, it does not materially aid in the retention of moisture. The water retention capacity of the underlying rocks ranges from very porous to very dense.

A high percentage of the precipitation in the Rocky Mountains occurs as snow. Accumulating to great depths during the winter months, especially on the windward slopes of the higher ranges, it melts during the late spring. Over much of this area, the base flows of the streams are maintained from ground water. This storage, combined with the area's general forest cover, tends to even out streamflows.

GROUND WATER

Ground water is an important regional resource. Large quantities of water are obtained from wells and much surface water originates from aquifer discharge. This discharge is especially important during extended fair weather periods when the flow of many streams is mostly or entirely composed of ground-water effluent. There are approximately 550 million acre-feet of ground-water storage in the top 50 to 100 feet of the water bearing strata (table 2).

About 42 percent of the region is underlain by aquifer units with low porosity and permeability that generally yield only small supplies of ground water. Fortunately these units occur mainly in thinly populated areas where water needs are

comparatively small and surface water supplies are plentiful. A small percentage of the wells yield moderate quantities of water, sufficient for a small community, industrial, or commercial supply. The distribution of ground-water resources by aquifer units is summarized in table 6.

West of the Cascade Range, the major aquifers are chiefly sand and gravel in the alluvial and glacial deposits. Many wells having moderate to large yields have been drilled in these deposits in the Puget Sound Subregion and in the Willamette, Cowlitz, Chehalis, and other river valleys.

In the plateaus of central and eastern Washington, north-central and northeastern Oregon, and west-central Idaho (parts of Subregions 1, 2, 3, 6, and 7) basalt of the Columbia River Group and similar basalt is the most widespread major aquifer and yields moderate to large quantities of water to many wells. Recharge from direct precipitation is generally small, but some areas receive additional recharge from streams draining adjacent mountain areas or from irrigation seepage. Over large areas of the plateau, however, recharge is entirely from the scanty local rainfall which limits the quantity of ground water that can be obtained.

Alluvial deposits are important aquifers along the Columbia River downstream from Grand Coulee Dam; in the Spokane, Okanogan, Yakima, and Walla Walla River valleys; and in the Ephrata-Moses Lake and Pasco areas. The alluvial deposits also are major aquifers in valleys in northern Idaho and Montana in such places as the Rathdrum Prairie, and the Bitterroot, Flathead, Kootenai, and similar valleys.

Volcanic rocks, sedimentary strata, and valley alluvial deposits are important aquifers in south-central and southeastern Oregon and the southwestern corner of Idaho but wells have been developed only at a few places. The great depth to water at some places makes utilization of ground water expensive.

Extensive aquifers underlie the Snake River Plain and more ground water is withdrawn in that area than in any other part of the region. Basalt is the major aquifer in the eastern Snake River Plain (Subregion 4) but alluvial deposits are important near the Snake River and in tributary valleys. In western Idaho (Subregion 5), alluvium, basalt, silicic volcanic rocks, and sedimentary deposits are all important aquifers.

The several hundred geologic formations have been grouped into nine aquifer units (table 6) in accordance with their characteristics. Each unit is described in more detail in Appendix V, Water Resources.

Table 6 - Summary of Storage, Recharge, and Discharge of Ground Water in Aquifer-unit Groups
Columbia-North Pacific Region

Aquifer-unit Group	Area: Square Miles (thousands)	Area: Acres (millions)	Quantity of Water in Storage (millions of ac-ft)	Gross Annual Natural Recharge and Natural and Pumped Discharge (millions of ac-ft)
1. Alluvial and Glacial Deposits	41.3	26.5	270	36
2. Younger Volcanic Rocks	28.9	18.5	80	28
3. Younger Sedimentary Rocks	16.1	10.3	80	2
4. Silicic Volcanic Rocks	7.7	4.9	10	1
5. Volcanic Rocks of Middle Tertiary Age	58.0	37.2	38	10
2-5. Volcanic and Sedimentary Rocks, Undifferentiated	5.5	3.5	18	0.5
6. Older Volcanic Rocks	13.5	8.6	8	7
7. Older Sedimentary Rocks	11.4	7.3	4	6
8. Older Volcanic and Sedimentary Rocks	6.5	4.2	3	1
9. Pre-Tertiary Rocks, Undifferentiated	82.3	52.6	47	29
Total	271.2	173.6	558	120.5

Source: Appendix V, Water Resources.

The source of recharge is precipitation which reaches aquifers in a variety of ways depending on such factors as the amount and rate of precipitation, the character of the aquifer and overlying material, the pattern and spacing of surface drainage, and the slope of the terrain. Chief immediate sources of recharge or ways in which recharge occurs include: direct filtration of precipitation, snowmelt, delayed infiltration, seepage from streams, seepage from irrigation (canals, laterals, fields), and lateral or vertical inflow from adjacent aquifers.

Ground-water discharge is a significant component of the streamflow in many basins. The gross annual natural recharge to and the gross annual natural and pumped discharge from the different aquifer unit groups in the region are given in table 6.

The quality of ground water generally ranges from good to excellent for most uses. Water from alluvial deposits and volcanic rocks west of the Cascade Range and in the humid areas east of the Cascade Range usually has less than 300 mg/l dissolved solids. The water normally ranges from soft to hard (from less than 60 mg/l to more than 120 mg/l). In the arid and semiarid areas, the ground water has slightly higher concentrations of dissolved solids than in the humid areas, but still is generally less than 500 mg/l, except in the Oregon Closed Basins where concentrations of 500 to 1,000 mg/l are fairly common.

LAND

When the land resources are considered, the diversity of the Columbia-North Pacific Region is again evident. Fertile farmlands, barren mountains, forest lands, and sagebrush deserts are all abundant and are all part of the land resource base. The total regional area of nearly 174 million acres is distributed amoung the four following major cover and use types: (1) cropland, 20.8 million acres; (2) rangeland, 58.8 million acres; (3) forest land, 85.8 million acres; and (4) other land, 8.3 million acres. Cropland is found in the valleys and lower plateaus throughout the region, while rangeland primarily occupies the drier areas between the Cascades and Rocky Mountains. Forest lands are well distributed

Table 7 - Land Area by State & Subregion, 1966
Columbia-North Pacific Region

Sub-region	Units	Idaho	Montana	Nevada	Oregon	Utah	Washington	Wyoming	Total
1	1,000 ac	4,665.0	15,921.6	-	-	-	2,232.8	-	22,819.4
	sq mi	7,289.0	24,877.5	-	-	-	3,488.8	-	35,655.3
2	1,000 ac	-	-	-	-	-	14,080.8	-	14,080.8
	sq mi	-	-	-	-	-	22,001.3	-	22,001.3
3	1,000 ac	-	-	-	-	-	3,851.4	-	3,851.4
	sq mi	-	-	-	-	-	6,017.7	-	6,017.7
4	1,000 ac	18,232.3	-	973.6	-	240.9	-	3,235.0	22,681.8
	sq mi	28,488.0	-	1,521.3	-	376.4	-	5,054.7	35,440.4
5	1,000 ac	12,193.5	-	2,322.9	8,881.1	-	-	-	23,397.5
	sq mi	19,052.5	-	3,629.6	13,876.7	-	-	-	36,558.8
6	1,000 ac	15,694.3	-	-	3,168.2	-	3,508.7	-	22,371.2
	sq mi	24,522.3	-	-	4,950.3	-	5,482.4	-	34,955.0
7	1,000 ac	-	-	-	15,366.6	-	3,455.6	-	18,822.2
	sq mi	-	-	-	24,010.3	-	5,399.3	-	29,409.6
8	1,000 ac	-	-	-	162.6	-	3,030.0	-	3,192.6
	sq mi	-	-	-	254.1	-	4,734.4	-	4,988.5
9	1,000 ac	-	-	-	7,602.8	-	-	-	7,602.8
	sq mi	-	-	-	11,879.4	-	-	-	11,879.4
10	1,000 ac	-	-	-	10,984.5	-	4,069.7	-	15,054.2
	sq mi	-	-	-	17,163.2	-	6,358.9	-	23,522.1
11	1,000 ac	-	-	-	-	-	8,446.6	-	8,446.6
	sq mi	-	-	-	-	-	13,197.8	-	13,197.8
12	1,000 ac	-	-	-	11,394.8	-	-	-	11,394.8
	sq mi	-	-	-	17,804.3	-	-	-	17,804.3
Region	1,000 ac	50,785.1	15,921.6	3,296.5	57,560.6	240.9	42,675.6	3,235.0	173,715.3
	sq mi	79,351.8	24,877.5	5,150.9	89,938.3	376.4	66,680.6	5,054.7	271,430.2

Source: Appendix IV, Land & Mineral Resources.

throughout the western sections and at higher elevations in the eastern part. Other land, which is composed of very diverse use and cover types, is found in every part of the region. Table 7 shows land area by State and subregion.

Land Capability

Land capability classification is based on soil characteristics, qualities, behavior, and response to agricultural uses. Soil characteristics (such as depth, texture, structure, presence of aggregate, wetness, reaction, and slope), and soil qualities (such as permeability, erosion hazard, overflow hazard, water-holding capacity, inherent fertility, and climatic conditions as they influence use and management of land) are considered in grouping soils into eight land capability classes. Class I land has few hazards or limitations that restrict its use for agriculture. On the other hand, Class VIII land has many limiting soil and land characteristics for crop production. However, areas of Class VIII land, as well as land in other classes, may be extremely valuable for recreation, wildlife habitat, water supply, or esthetics.

Table 8 summarizes acreages by land capability classes for each subregion and the region. The capability classifications can be broken into two divisions: (1) Classes I through IV are suitable for cultivation and other use, while (2) Classes V through VIII are generally unsuitable for cultivation but are suitable for range, forest, recreation, wildlife habitat, and water supply. These land capability classes are divided into subclasses to indicate the dominant limitation or hazard. These subclasses, in order of priority, are "e" water or wind erosion, "w" wetness or frequent inundation from overflow, "s" soil limitation, and "c" climatic limitation. This interpretation of the hazards and limitations in the agricultural use of land does not evaluate its productivity nor rate its suitability for forest and range uses.

The regional total of 36,164,000 acres in Classes I through IV includes 20.8 million acres currently cultivated, plus potentially arable lands. This total, plus 15 million acres of Class VI desert lands in Subregions 1 through 7 and Subregion 12 estimated to be suitable for cropping under irrigation, constitutes the 51,064,000 acres of arable land in the region which appears in the summary of water and land resources (table 2).

Table 8 - Summary of Land Capability Classes, 1966
Columbia-North Pacific Region

Land Capability Subclass1/	Subregions												
	1	2	3	4	5	6	7	8	9	10	11	12	Total
							(1,000 ac)						
I	1.0	69.1	51.8	-	43.6	3.0	20.0	11.6	171.5	1.8	-	-	373.4
IIe	132.8	324.5	110.5	386.4	233.3	385.8	211.1	56.9	279.9	229.6	-	26.0	2,376.8
IIw	95.6	42.8	41.9	3.0	81.5	1.2	-	116.6	305.4	256.3	305.0	8.5	1,257.8
IIs	88.0	132.7	102.9	39.3	151.5	37.1	128.7	43.5	320.9	94.6	10.0	-	1,149.2
IIc	98.7	-	-	140.5	12.0	-	216.0	-	-	22.0	-	60.0	549.2
Total II	415.1	500.0	255.3	569.2	478.3	424.1	555.8	217.0	906.2	602.5	315.0	94.5	5,333.0
IIIe	777.3	1,915.4	266.6	1,506.1	421.7	2,253.5	1,680.8	200.0	530.7	443.1	148.0	130.0	10,273.2
IIIw	67.8	72.7	41.9	31.1	91.3	111.1	12.0	104.6	256.3	232.8	315.0	300.0	1,636.6
IIIs	228.3	330.3	22.1	523.0	333.6	132.8	214.4	130.1	64.9	167.9	58.0	80.0	2,285.4
IIIc	62.2	199.6	-	173.2	10.4	-	67.0	-	-	-	-	-	512.4
Total III	1,135.6	2,518.0	330.6	2,233.4	857.0	2,497.4	1,974.2	434.7	851.9	843.8	521.0	510.0	14,707.6
IVe	2,070.7	1,175.2	320.1	399.4	338.0	687.6	2,724.5	233.2	575.2	1,317.6	866.0	175.0	10,882.5
IVw	136.9	35.0	29.7	50.2	9.0	76.3	45.0	189.8	245.7	469.6	72.0	85.0	1,444.2
IVs	732.2	292.9	75.4	250.3	78.5	65.5	268.0	43.7	51.3	331.9	293.0	155.0	2,637.7
IVc	63.2	-	-	424.3	64.1	104.0	-	-	-	-	-	130.0	785.6
Total IV	3,003.0	1,503.1	425.2	1,124.2	489.6	933.4	3,037.5	466.7	872.2	2,119.1	1,231.0	545.0	15,750.0
Vw	144.0	10.0	-	156.1	52.4	12.0	34.0	-	1.8	-	-	385.0	795.3
Vs	-	-	-	32.0	-	-	-	-	-	-	-	-	32.0
Vc	-	-	-	12.0	48.2	-	-	-	-	-	-	-	60.2
Total V	144.0	10.0	-	200.1	100.6	12.0	34.0	-	1.8	-	-	385.0	887.5
VIe	14,850.1	7,160.0	2,454.1	13,125.5	17,402.2	14,203.6	10,851.9	1,597.2	4,390.8	10,005.5	4,645.2	6,325.3	107,011.4
VIw	49.5	-	-	-	-	13.5	-	48.6	-	122.8	32.0	170.0	436.4
VIs	456.7	1,167.1	122.7	1,218.3	114.0	186.8	431.5	214.7	161.0	397.9	421.0	980.0	5,871.7
VIc	11.0	-	-	1,004.7	520.0	-	-	-	-	-	-	20.0	1,555.7
Total VI	15,367.3	8,327.1	2,576.8	15,348.5	18,036.2	14,403.9	11,283.4	1,860.5	4,551.8	10,526.2	5,098.2	7,495.3	114,875.2 2/
VIIe	1,415.7	804.2	101.5	1,648.1	1,702.2	2,924.6	1,032.6	92.1	90.4	702.9	827.4	932.1	12,273.8
VIIw	0.6	-	-	-	-	-	-	-	-	24.8	12.0	20.0	57.4
VIIs	150.7	92.8	63.7	56.8	356.5	391.7	680.9	34.4	28.6	67.4	27.0	1,307.9	3,258.4
Total VII	1,567.0	897.0	165.2	1,704.9	2,058.7	3,316.3	1,713.5	126.5	119.0	795.1	866.4	2,260.0	15,589.6
VIII	1,186.4	256.5	46.5	1,501.5	1,333.5	781.1	203.8	75.6	128.4	165.7	415.0	105.0	6,199.0
Total Land	22,819.4	14,080.8	3,851.4	22,681.8	23,397.5	22,371.2	18,822.2	3,192.6	7,602.8	15,054.2	8,446.6	11,394.8	173,715.3

1/ Subclasses are: "e" water or wind erosion, "w" wetness of frequent inundation from overflow, "s" soil limitation, and "c" climatic limitation.
2/ An estimated 15 million acres are suitable for cultivation for crops when irrigated.
Source: Appendix IV, Land and Mineral Resources.

Potentially Irrigable Lands

Approximately 31.7 million acres have been identified as potentially irrigable. Under irrigation, these lands would be suited for the production of climatically adapted agricultural crops, although in some cases they may have greater potential for nonagricultural uses. An additional 1.2 million acres, in an "other" potentially irrigable category, are primarily suited to producing limited forage for wildlife and livestock grazing but are not generally suitable for more intensive uses. A summary of potentially irrigable lands is shown in table 9.

Nearly half of the potentially irrigable lands--more than 14 million acres--were placed in irrigability Classes 1 and 2. Under irrigation, they would be suited to the production of a wide variety of climatically adapted crops and could be farmed and irrigated by modern equipment and methods. These lands are generally suited for gravity methods of irrigation. Class 3 is only fair to marginal quality for irrigation development, being limited in both crop productivity and land use.

Table 9 - Potentially Irrigable Land by Class[1/], Columbia-North Pacific Region

Area and Subregion		Class 1 (acres)	Class 1 (percent)	Class 2 (acres)	Class 2 (percent)	Class 3 (acres)	Class 3 (percent)	Other[2/] (acres)	Other[2/] (percent)	Total (acres)	Percent of Grand Total
Area A											
Subregion	1	110,900	(4)	645,800	(26)	1,753,700	(70)	-	-	2,510,400	8
	2	451,000	(15)	1,116,800	(38)	1,403,500	(47)	-	-	2,971,500	9
	3	60,100	(9)	262,400	(42)	309,400	(49)	-	-	631,900	2
Total		622,200	(10)	2,025,000	(33)	3,466,600	(57)	-	-	6,113,800	19
Area B											
Subregion	4	717,200	(16)	1,797,200	(40)	1,572,600	(35)	375,900	(9)	4,462,900	14
	5	463,200	(9)	1,443,200	(29)	2,415,200	(48)	734,500	(14)	5,056,100	15
	6	170,700	(5)	1,067,500	(32)	2,082,000	(61)	70,900	(2)	3,391,100	10
Total		1,351,100	(11)	4,307,900	(33)	6,069,800	(47)	1,181,300	(9)	12,910,100	39
Area C											
Subregion	7	692,400	(12)	2,360,400	(41)	2,672,400	(47)	-	-	5,725,200	17
	9	318,400	(21)	528,500	(35)	655,900	(44)	-	-	1,502,800	5
	10S	82,600	(10)	304,200	(38)	417,600	(52)	-	-	804,400	2
	12	165,000	(6)	570,900	(19)	2,198,500	(75)	-	-	2,934,400	9
Total		1,258,400	(12)	3,764,000	(34)	5,944,400	(54)	-	-	10,966,800	33
Area D											
Subregion	8	68,400	(12)	138,800	(25)	351,500	(63)	-	-	558,700	2
	10N	35,200	(4)	289,900	(36)	494,200	(60)	-	-	819,300	2
	11	29,300	(2)	218,000	(14)	1,272,300	(84)	-	-	1,519,600	5
Total		132,900	(5)	646,700	(22)	2,118,000	(73)	-	-	2,897,600	9
Region		3,364,600	(10)	10,743,600	(33)	17,598,800	(53)	1,181,300	(4)	32,888,300	100
Rounded		(3,400,000)		(10,700,000)		(17,600,000)		(1,200,000)		(32,900,000)	
State											
Idaho		1,152,900	(13)	3,306,300	(39)	3,454,700	(40)	683,800	(8)	8,597,700	26
Montana		29,700	(2)	157,500	(13)	1,050,300	(85)	-	-	1,237,500	4
Nevada		17,900	(2)	150,400	(21)	505,100	(70)	49,500	(7)	722,900	2
Oregon		1,014,200	(9)	3,979,600	(34)	6,362,700	(53)	448,000	(4)	11,804,500	36
Utah		0	(0)	13,200	(52)	12,400	(48)	-	-	25,600	-
Washington		1,145,300	(11)	3,126,700	(30)	6,160,300	(59)	-	-	10,432,300	32
Wyoming		4,600	(7)	9,900	(15)	53,300	(78)	-	-	67,800	-

1/ Does not include 7,344,000 acres of land presently irrigated in 1966.
2/ Bureau of Land Management-designated lands generally not meeting the potentially irrigable land classification specifications used for this study.
Source: Appendix IX, Irrigation.

MINERALS

The region's mining industry is characterized by large, well established operations which have been in production for many years and have sufficient reserves for many more. The mines are principally producers of metals such as gold, silver, copper, lead, zinc, antimony, and mercury. Equally important are the industrial mineral operations found throughout the region, such as those producing sand and gravel, crushed rock, limestone, pumice, expandable shale, brick and tile clay, and refractory clay.

Although the Columbia-North Pacific Region has less mineral wealth than some other parts of the Nation, mineral resources are important in its economy and provide vital raw materials for both regional and national industries. Approximately $10 billion worth of minerals have been extracted from the region's mines and quarries. Mineral resources are classified generally as metals, nonmetals, and mineral fuels.

Metals

The region's two outstanding metal producing areas are the Coeur d'Alene area in Idaho and the Butte district in Montana. Principal resources are copper, silver, gold, lead, and zinc. A third major area is in Pend Oreille and Stevens counties in northeastern Washington. In addition, many other smaller productive or potentially productive areas are scattered throughout the region.

Major copper deposits in the Butte area are expected to be able to produce copper at the current rate for many years. The once productive Heddleston district, north of Butte, has been revived and is expected again to be a major copper producer. Over 50,000 tons of copper are indicated to be in the Miners Ridge (Glacier Peak) area, Washington; however, no production has come from this deposit.

In the Coeur d'Alene area, estimates of silver-lead-zinc ores indicate a minimum of 10 years' production at current rates. Exploration is active in this area, where 90 to 98 percent of estimated reserves in Idaho are located.

Large potential resources of low grade lead and zinc ores exist in northeastern Washington. Known reserves equal 40 years at current annual production rates, and estimated reserves over 100 years.

Placer gold has been produced. Western Montana, northeastern Oregon, and southwestern Oregon are the major potential for gold.

Resources near Republic, Washington, appear sufficient for several years at present production rates from one of the few currently operating gold mines in the Nation. Other deposits are scattered throughout the region, but are not economic to mine under present market conditions.

Large reserves of manganese ores are found in western Montana. These have been developed in recent times and manganese production has in some years accounted for a large share of national output.

Uranium ore is available in two deposits north of Spokane, Washington, and recent additional discoveries make resumption of mining and milling in the area likely. Smaller deposits have been located in other areas.

The Nation's only nickel currently being mined comes from Nickel Mountain near Riddle, Douglas County, Oregon. Estimated reserves are sufficient for 10 to 15 years at present production rates. Oregon also contains the major cinnabar deposits, which are located in the central and eastern part of the State.

Idaho had deposits of tungsten, antimony, mercury, cobalt-columbian-tantalum, and rare earth metals. Potential reserves of these metals are adequate for several years' production.

Nonmetals

Regional nonmetal reserves, both in tonnage and value, are primarily construction industry items such as sand and gravel, stone, and clay. As low unit value items, they must be produced near the market.

Sand and gravel deposits are widespread and the supply virtually inexhaustible, but deposits near urban markets or convenient to construction sites are becoming more critical.

Limestone is widespread but varies greatly in purity. It has many uses and the resource is very large and adequate for the foreseeable future.

Clay, also widespread, is used largely according to its physical and mineralogical character. Common clays are most prevalent and are used mostly near urban centers for common brick and tile. Sources of high grade refractory or high alumina clays of greater value are more limited. Overall, enormous clay reserves are available.

Phosphate rock production is of major importance, as it is used in making fertilizers, elemental phosphorus, and some minor products. Reserves are estimated at several billions of tons.

The principal source of vermiculite for the United States is in this region. Resources are extensive and the outlook for increased future production is favorable. Flourspar deposits near Darby, Montana, have several years' reserves available. Barite, garnet, and magnesite are other nonmetals available in the region and resources are generally adequate for the foreseeable future. Since World War II, Washington has been the largest producer of magnesite. Reserves are still available. The olivine reserve in Washington is one of the largest deposits known in the Nation.

Mineral Fuels

The region's coal reserves, most of which are in western Washington, are estimated to total 6.2 billion tons. Interest in coal has been revived recently with construction of a coal-fired thermal-electric plant near Centralia to supplement the present hydroelectric generation. Southern Oregon also contains some formerly productive coal fields in the Coos Bay area, but there has been very little activity in recent years.

No producing oil or gas fields exist in the region, although considerable exploratory drilling has found small quantities of both.

PRESENT RESOURCE MANAGEMENT AND USE

PRESENT RESOURCE MANAGEMENT AND USE

The development and use of water and related land resources helps maintain an employment base in the Columbia-North Pacific Region. Hydroelectric power and the abundance of water provide an impetus to industrialization. Over 7 million acres of cropland are under irrigation. Food processing and manufacturing have gone hand in hand with these developments. Navigation, harbors, and waterways have been expanded and extended. Population has increased with the growth of employment and business opportunities. With this growth the demand for outdoor recreation, including sport fishing and hunting, has accelerated rapidly. Unfortunately, this growth has reduced the habitat available to many species of fish and wildlife.

There is an extensive system of Federal, State, local government, and private water resource development projects. Many new programs and projects are being initiated to keep pace with the expanding needs. With many of these varied developments, man can modify the high environmental values of mountains, forests, streams, lakes, and estuaries which are some of the greatest assets. Accordingly, the region is now confronted with the problem of retaining its high quality fishery and natural environment while sustaining an acceptable level of development and growth.

The Constitution of the United States provides the Federal Government with broad powers relating to water and land resource development under the Commerce, Property, General Welfare, and Treaty clauses. Of particular importance to future use of water is the grant of power under the Property Clause which permits the United States to reserve sufficient water in waterways which cross or abut lands reserved for Federal purposes to carry out the purpose for which the lands were reserved. Arizona v. California, 373 U.S. 546, 600, 601 (1963); FPC v. Oregon, 349 U.S. 435 (1955).

Over the years, a series of compacts and treaties have evolved which must be recognized and considered in planning for the management and use of water. During the period of 1853 to 1864, the United States entered into 14 treaties with Indian tribes in the region. Under the terms of these treaties, reservations were established. The United States Supreme Court has held that, in treaties creating Indian reservations, the right to use water from streams and rivers on, bordering, or traversing Indian reservations was reserved by the United States along with the reservation of the land itself. Winters v. United States, 207 U.S. 564 (1908). Further, the quantity of water so reserved was not limited to the

amount of water used at the time the Indian reservations were established. Conrad Ins. Co. v. United States, 161 F. 829, 835 (9th Cir. 1908). The United States Supreme Court has also held that, with respect to the water rights reserved for the Indians for use on Indian reservations, such waters are exempt from appropriation under State law. Winters v. United States, supra.

International treaties, such as the 1910 Boundary Waters Treaty with Canada and the 1964 Columbia River Treaty with Canada, are of particular importance to the Columbia River System. In the latter treaty, the United States has agreed to operate the existing hydroelectric plants and any new projects on the main stem of the Columbia River so as to make the best use of Canadian storage and thereby produce the maximum amount of power benefits possible for sharing by the two countries. Canada's entitlement is one-half of the downstream power benefits produced in the United States by Canadian storage. In addition, the three Canadian storage projects shall reserve up to 8.45 million acre-feet of flood control space on May 1 of each year with an additional 12 million acre-feet available as "on-call" storage.

The operation of the Columbia River system has become complex requiring the continuous coordination of many diverse groups. Coordination is accomplished by the Columbia River Management Group, an interagency operating body, the Pacific Northwest Coordination Agreement entered into in September 1964 by 16 electrical power systems, and the Flood Control Operating Plan which includes Columbia River Treaty Storage.

With the diverse ownership of dams on the Columbia River and the constraint composed by treaties and compacts, a plan of coordinated operation has been carried out over 30 years. This operation considers all uses and has been successful in providing adequate control measures. The success is possible because the runoff patterns are well known months in advance which permits water and reservoir operation to be scheduled for various uses long before the critical periods are reached. In general, results of this effort have been to reduce winter and spring floodflows on the main stem and to augment flows during the low water season.

Details on treaties, compacts, management organizations, and State and Federal legislation are given in Appendix III, Legal & Administrative Background. The management and use of water resources are set forth in Appendix V, Water Resources, Appendix VII, Flood Control, and Appendix XV, Electric Power.

WATER DEVELOPMENT AND CONTROL

Storage

Almost every major stream in the Columbia-North Pacific Region is controlled to some degree by storage dams that serve a variety of purposes. In total, there are 194 reservoirs with a storage capacity of 5,000 acre-feet or more. These reservoirs have a total active storage capacity of more than 40 million acre-feet (table 10), making them a valuable asset in the use and management of the water resources. An extensive and growing recreational use has resulted from these reservoirs, although they were constructed primarily for other purposes. Reservoir releases during the low water season have restored or preserved resident and anadromous fish in some streams.

Table 10 - Storage Reservoirs 5,000 Ac-Ft or More Active Storage, 1970
Columbia-North Pacific Region

Area & Subregion	No.	Storage Volume Gross (ac-ft)	Storage Volume Active (ac-ft)	Surface Area (acres)
Area A				
Subregion 1	31	14,391,040	11,479,180	382,596
2	17	14,074,189	7,577,989	230,304
3	6	1,070,700	1,070,700	15,954
Total	54	29,535,929	20,127,869	628,854
Area B				
Subregion 4	25	6,101,125	5,417,480	196,218
5	36	5,895,140	4,598,580	120,813
6	9	5,497,650	1,631,130	59,810
Total	70	17,493,915	11,647,190	376,841
Area C				
Subregion 7	16	6,040,920	1,814,100	149,185
9	19	2,594,550	2,017,300	36,791
10S	9	166,450	168,795	4,975
12	1	21,500	17,400	-
Total	45	8,823,420	4,017,595	190,951
Area D				
Subregion 8	5	3,292,380	2,200,910	14,570
10N	0	0	0	0
11	20	3,202,100	2,425,800	45,294
Total	25	6,494,480	4,626,710	59,864
Region	194	62,347,744	40,419,364	1,256,510

Source: Appendix V, Water Resources

There are 26,090 small reservoirs, ranging in size from a fraction of an acre-foot to 5,000 acre-feet, which store nearly 400,000 acre-feet. These reservoirs are also used for a variety of purposes. Most of the smaller ones are farm ponds used for stock watering, recreation, irrigation, etc. Their major contribution to water management is through the retention of runoff during high precipitation periods for use during dry seasons. Although overall effect on the total runoff patterns is limited, on some watersheds they are important. The major contribution of these small reservoirs is in the Snake River Basin and Mid Columbia Subregion, where they are extensively used for stock watering on rangeland.

Levees and Channelization

Levees and channel improvements were the earliest flood control structures and remain among the more important structural measures. Stream channelization, modification, and improvement are employed to some extent almost everywhere in the region. Most modifications involve flood control, conservation, and drainage and comprise levees, revetments, channel widening and straightening, and bank stabilization. Table 11 summarizes local protection measures.

Table 11 - Summary, Levees & Channel Improvements, 1970
Columbia-North Pacific Region

Area & Subregion	Levees	Channel Improvement and Stabilization (miles)	Protection
Area A			
Subregion 1	161	1,168	488
2	20	203	205
3	64	128	-
Total	245	1,499	693
Area B			
Subregion 4	171	119	131
5	48	192	1,042
6	29	436	407
Total	248	747	1,580
Area C			
Subregion 7	72	366	106
9	-	368	115
10S	120	255	166
12	-	-	-
Total	192	989	387
Area D			
Subregion 8	449	100	176
10N	82	128	37
11	578	-	129
Total	1,109	228	342
Region	1,794	3,463	3,002

Source: Appendix VII, Flood Control

The projects range from improvements on small creeks, where material has been taken from the channel and placed on the banks, to massive levees 25 to 30 feet high designed to withstand major floods on the Columbia River. The degree of protection is equally variable. Some minor levees are overtopped almost every year while others effectively protect urban areas against floods as infrequent as once in a hundred years.

For additional information see Appendices VII, Flood Control, and VIII, Land Measures & Watershed Protection.

Instream Use

The waters of the region are used over and over again for production of hydroelectric power, for recreation, for navigation, fish and wildlife, and for water quality control. The flowing waters in the streams represent a major part of the natural environment.

Hydropower

Hydroelectric power ranks as a dominant instream use of the region's water. It is absent only in Washington's sector of Subregion 10 and in Oregon's Closed Basin, Subregion 12. Each drop of runoff is used an average of three times for power production.

Well over 90 percent of the electric generating capacity of 18,963 megawatts as of December 31, 1969, was hydroelectric. In addition, there were 9,167 megawatts of capacity under construction of which about 85 percent was hydroelectric.

About half of the existing capacity is installed at Federal multipurpose hydroelectric projects of which all but a few minor plants are a part of the Federal Columbia River Power System, whose production is marketed by the Bonneville Power Administration. In addition to the 8,517 megawatts of existing Federal hydro capacity, there are 7,263 megawatts of Federal hydro capacity under construction.

The non-Federal utilities have 120 hydroelectric projects with an installed hydroelectric capacity of about 9,188 megawatts. Added capacity of 501.6 megawatts is being installed at the Rocky Reach project of Chelan County PUD.

Table 12 lists hydroelectric plants, existing and under construction, by ownership and capacity.

Table 12 - Hydroelectric Plants Existing and Under Construction by Ownership and Nameplate Rating, January 1970, Columbia-North Pacific Region

Type	Number of Plants	Name Plate Rating (kw)
Federal	30	8,516,670
Public (non-Federal)	38	5,509,561
Private	82	3,678,702
Total	150	17,704,933

The bulk of the region's generating capacity is located on the Columbia River where the plants are both federally and non-federally owned. The firm capabilities of these plants are greatly enhanced by reservoir storage. Table 13 shows the storage at major reservoirs. The total usable for power generation is nearly 45 million acre-feet, of which about 31 million acre-feet are in existing projects and nearly 14 million are under construction. This storage is operated in direct coordination for the Columbia River Power System. Additional power benefits result from storage in minor projects and in reservoirs constructed for nonpower purposes.

Table 13 - Major Reservoirs Usable for Power
Columbia-North Pacific Region

Planning Area	Reservoir	Storage Usable for Power (1,000 ac-ft)
Canada	Arrow	7,145
	Duncan	1,411
	Kootenay Lake	565
	Mica1/	7,000
Area A	Hungry Horse	3,161
	Flathead Lake	1,219
	Libby1/	4,965
	Noxon Rapids	231
	Priest Lake	70
	Albeni Falls	1,155
	Coeur d'Alene Lake	223
	Long Lake	104
	Grand Coulee	5,232
	Lake Chelan	677
Area B	Dworshak 1/	2,000
	Palisades	1,202
	American Falls	45
	Minidoka	95
	Anderson Ranch	423
	Cascade	653
	Brownlee	980
Area C	John Day	535
	Round Butte	274
	Hills Creek	244
	Lookout Point	337
	Cougar	154
	Green Peter	313
	Foster	29
	Detroit	321
	Timothy Lake	62
Area D	Swift No. 1	447
	Yale	190
	Merwin	115
	Packwood Lake	3
	Mossyrock	1,298
	Cushman	372
	Alder	180
	White River	43
	Ross	1,052
	Upper Baker	185
	Lower Baker	142
Region		44,852

1/ Under Construction.
Source: Appendix XV, Electric Power.

Recreation

Water related recreation use of rivers, reservoirs, and lakes includes water contact activities (boating, fishing, swimming, and water skiing) and related non-contact activities (picnicking, camping, and sightseeing). This use amounted to about 77 million recreation days in 1965 or 41 percent of the total recreation days engaged in that year (table 14). The economic significance of this use is immense.

Most parts of the region contain streams and water bodies which provide opportunities for numerous recreation uses in a highly attractive natural environment. Numerous mountain lakes add much to scenic and esthetic values and provide many recreation opportunities. On some lakes, which serve as municipal water supply reservoirs, water contact activities are restricted.

Water quality improvement in certain areas, such as the lower Willamette River where recreation needs are great, has resulted in substantially increased uses such as swimming and water skiing. This improvement also upgraded fish habitat. Properly operated headwater impoundments often enhance streamflow quality.

Some rivers in the region have been identified as having national or state significance in their natural state and have been designated to remain in this status.

Competition for recreation resources has led to some conflicts between groups of recreationists: for example, between those who sail and those who water ski, or between those who use motorized recreation vehicles and those who seek peace and solitude. Such conflicts are becoming severe, especially on smaller water bodies, as the number of recreationists using fixed resources continues to increase.

Table 14 - Recreation Use, by Area and Subregion, 1965
Columbia-North Pacific Region

Area & Subregion	Water Related	Other	Total
	(1,000	recreation	days)
Area A			
Subregion 1	6,248	9,772	16,020
2	5,704	6,971	12,675
3	2,823	3,313	6,136
Total	14,775	20,056	34,831
Area B			
Subregion 4	5,119	7,367	12,486
5	3,823	8,123	11,946
6	3,126	3,669	6,795
Total	12,068	19,159	31,227
Area C			
Subregion 7	5,319	5,997	11,316
9	14,300	14,224	28,524
10S	8,657	11,018	19,675
12	227	719	946
Total	28,503	31,958	60,461
Area D			
Subregion 8	1,285	3,146	4,431
10N	5,771	7,346	13,117
11	14,500	30,653	45,153
Total	21,556	41,145	62,701
Region	76,902	112,318	189,220
Percent	41	59	100

Source: Appendix XIII, Recreation, and Comprehensive Water and Related Land Resource Studies of the Willamette River Basin (Subregion 9), and Puget Sound & Adjacent Waters (Subregion 11) adjusted to include the private sector.

Fish and Wildlife

The region is rich in fish and wildlife resources. In most parts they constitute an important recreation asset; in the Lower Columbia, Puget Sound, and a number of coastal estuaries, the commercial fishery is an important economic activity. The distribution of user-days for sport fishing and hunting and the pounds of commercial fish landed are shown in table 15.

Table 15 - Fishing and Hunting Use, by Area and Subregion, 1970
Columbia-North Pacific Region

Activity	Region Total	Area A 1	Area A 2	Area A 3	Area A Total	Area B 4	Area B 5	Area B 6	Area B Total	Area C 7	Area C 9	Area C 10S	Area C 12	Area C Total	Area D 8	Area D 10N	Area D 11	Area D Total
									(1,000 user-days)									
Sport																		
Fishing																		
Anadromous Fish	5,040	0	42	28	70	0	0	176	176	70	210	1,284	0	1,564	211	1,002	2,017	3,230
Resident Fish	14,527	1,510	2,704	753	4,967	705	610	686	2,001	1,047	994	860	129	3,030	679	340	3,510	4,529
Marine Fish	706	0	0	0	0	0	0	0	0	0	0	110	0	110	0	523	73	596
Shellfish	1,073	0	0	0	0	0	0	0	0	0	0	181	0	181	0	771	121	892
Total	21,346	1,510	2,746	781	5,037	705	610	862	2,177	1,117	1,204	2,435	129	4,885	890	2,636	5,721	9,247
Hunting																		
Big Game	4,800	400	406	217	1,023	336	335	830	1,501	669	326	323	111	1,429	220	264	363	847
Upland Game	3,686	250	659	288	1,197	348	498	394	1,240	250	337	107	19	713	131	128	277	536
Waterfowl	1,436	100	276	104	480	176	156	75	407	63	111	36	23	233	47	61	208	316
Other Wildlife	582	75	28	10	113	80	98	120	298	40	80	26	5	151	7	3	10	20
Total	10,504	825	1,369	619	2,813	940	1,087	1,419	3,446	1,022	854	492	158	2,526	405	456	858	1,719
Grand Total	31,850	2,335	4,115	1,400	7,850	1,645	1,697	2,281	5,623	2,139	2,058	2,927	287	7,411	1,295	3,092	6,579	10,966
									(1,000 pounds)									
Commercial																		
Fishing																		
Anadromous Fish	44,769	0	0	0	0	0	0	0	0	0	0	10,556	0	10,556	2,753	14,435	17,025	34,213
Resident Fish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marine Fish	111,619	0	0	0	0	0	0	0	0	0	0	6,462	0	6,462	0	31,547	73,610	105,157
Shellfish	27,053	0	0	0	0	0	0	0	0	0	0	3,856	0	3,856	0	16,440	6,757	23,197
Total	183,441	0	0	0	0	0	0	0	0	0	0	20,874	0	20,874	2,753	62,422	97,392	162,567

Source: Appendix XIV, Fish & Wildlife, and Comprehensive Water Resource Studies of Willamette River Basin (Subregion 9) and Puget Sound & Adjacent Waters (Subregion 11). 1965 data used as 1970.

Fish In 1965, sport fishing use exceeded 21.3 million man days with associated expenditures of nearly $148 million. Commercial fish landings exceeded 183 million pounds of anadromous fish, marine fish, and shellfish valued at about $28 million.

Anadromous fish inhabit nearly all accessible rivers and streams tributary to the Pacific Ocean, Puget Sound, and the Columbia River. The most important species are the salmon and steelhead trout which account for more than 90 percent of the anadromous sport fishing and 95 percent of the anadromous commercial harvest. Anadromous fish represent about 20 percent of all sport fishing and nearly 25 percent of the commercial fishery.

No data are available on the few resident species, mostly kokanee and carp, that sustain commercial harvest. Trout and char are more highly regarded by most sport fishermen than other resident fish. Rainbow trout, the most widely distributed and numerous, are found in lakes and streams in every subregion. Resident fish accounted for more than 68 percent of all sport fishing in the region in 1965.

Compared to the resident and anadromous sport fishery, sport fisherman use of most species of marine fishes and shellfishes, except razor clams, is low. However, practically all bays and estuaries support bay clam and Dungeness crab sport fisheries. Recreational use of all shellfish was estimated to be 1,073,000 man-days in 1965. Ocean perch, rockfish, lingcod, flounders, greenling, and other marine fishes are caught both from shore and from sport fishing boats. Recreational use of marine fishes amounted to an estimated 706,000 angler-days in 1965. In coastal and ocean waters about 112 million pounds of marine fish were harvested commercially (some 60 percent of the total commercial fishery) and an estimated 27 million pounds of shellfish were caught.

Wildlife Big game resources include Rocky Mountain and Roosevelt elk; moose; black-tailed, white-tailed, and mule deer; pronghorn antelope; bighorn sheep; Rocky Mountain goat; mountain caribou; black and grizzly bear; and mountain lion. An estimated 4.8 million man-days of big game hunting was tallied in 1965, about 97 percent for deer and elk.

Upland game includes many native and introduced species. Among the latter are ring-necked pheasant, Hungarian partridge, and chukar. Several species of quail and grouse, mourning doves, and band-tailed pigeons are all common. Silver grey squirrels inhabit some areas. Ptarmigan are found in limited numbers and wild turkeys have been successfully introduced.

The region's many bays, estuaries, marshes, shallow lakes, and streams provide waterfowl habitat important for wintering, nesting, and resting during migrations. Waterfowl in the region includes many species; some year-long residents, some nesters, and some migrators and winter residents. The mallard is probably the most important in terms of hunter interest, followed by the Canada goose in its several varieties. Although the region produces many ducks, geese, and swans, it is primarily important for migration habitat. There are 21 national wildlife refuges and many State owned or managed areas dedicated to the protection, conservation, and use of waterfowl.

Fur bearing animals inhabit almost all areas in the region. Beaver, mink, muskrat, nutria, raccoon, and river otter usually stay near water and at relatively low elevations. Badger, bobcat, coyote, and kit fox inhabit open prairies and rough broken land. Fisher, lynx, marten, mountain lion, and wolverine are wilderness animals. Red and grey foxes, opossum, and spotted and striped skunks are usually animals of the farmlands although the red fox and weasel may live at relatively high elevations. Trapping has declined steadily since 1946, primarily due to low fur prices. Most furbearers are not harvested to the maximum. Some, however, such as fisher and wolverine, have become extremely rare and are protected.

In 1965 the hunter-days totaled approximately 10.5 million with associated expenditures of over $77 million.

Navigation

Navigable waterways are a valuable natural endowment of the region that have been used ever since man occupied the area. Navigation has become more important with regional growth and today occupies a significant place in the economy.

Navigation use includes deep and shallow draft ocean commerce, commercial fishing, inland commercial navigation, and recreational boating. The latter is an important use of water regionwide. Foreign and coastwise waterborne commerce totals over 45 million short tons annually. Commodity groups included in both categories were agricultural products, forest products, nonmetallic minerals, petroleum products, and miscellaneous. Primary metals, ores, and crude petroleum were included in the foreign and coastwise commerce only.

Internal movements of commerce total over 52 million tons annually of which 25.2 million are within Subregion 11 and 8.2 million are along the coast. The remaining 18.9 million tons annually are on the Columbia-Willamette-Snake River waterway with

about 90 percent being on the Columbia River below The Dalles and on the Willamette below Salem.

In the east part of the region commercial navigation is limited to movement of rafted logs to mills on a few isolated large bodies of water.

Deep draft commerce by ocean vessels occurs at 16 salt and fresh water ports. Navigation is important on the Columbia River between Astoria and the Portland-Vancouver area. Numerous navigation aids such as channels, groins, levee construction, bank stabilization, and jetties have been provided in this stretch.

Locks in Columbia and Snake River dams from Bonneville upstream extend river navigation up the Columbia to the Tri-City Area on Lake Wallula and 145 miles up the Snake River. Above McNary Reservoir on the Columbia River, navigation now is generally limited to log rafting on Franklin D. Roosevelt Lake and movement of general cargo to isolated communities on Lake Chelan. Open river navigation is possible, usually for recreation purposes, on many other river reaches such as on the Snake River to Hells Canyon Dam, the Middle Fork Salmon River, the mainstem Salmon River, and many parts of the Clearwater River.

Although the Willamette River is used for navigation from its mouth to Corvallis, a deep draft channel is maintained only to Portland. Major restrictions to Willamette navigation are the obsolete Willamette Falls locks at Oregon City and shallow channel up river.

There are four deep draft harbors developed along the coast of Oregon and Washington and twelve in the Puget Sound and lower Columbia River areas. Many smaller estuaries serve recreational, fishery, and other commercial functions. Most projects have received improvement such as jetties and breakwaters at the entrances and some channel dredging. Continual planning is needed in these estuaries to insure that a proper balance of use and development is maintained.

The Strait of Juan de Fuca, Puget Sound, and adjacent waters have many bays and inlets with deep waters which serve as harbors. In the Seattle area, a deep water channel with navigation locks connects Puget Sound with Lake Union and Lake Washington. The lower estuaries of the Snohomish and Duwamish Rivers are developed. In the lower Skagit River, navigation is limited to occasional log rafts.

Water Quality

Although water quality control is not a direct instream use such as fish, navigation, or recreation, the quality has a direct physical and economic impact on how the water is utilized.

In contrast to conditions in many other parts of the Nation, water quality in the Columbia-North Pacific Region is still generally very good. At the same time, however, serious pollution problems in several places result in poor quality water, damage to sport and commercial fisheries, and undesirable public health and esthetic conditions. Extensive cleanup of pollution sources in the Willamette River and Lake Washington has resulted in rapid improvement of water quality.

The most widespread and important problem from the public health aspect is that of bacterial contamination. Nearly every stream below major population centers fails to meet generally accepted coliform bacteria criteria for water-contact recreation and water supply sources.

Also particularly important are the areas of low dissolved oxygen, since salmonid fish require dissolved oxygen levels of at least 5.0 mg/l for migration and higher levels for rearing and spawning. Most dissolved oxygen problems result from the discharge of inadequately treated municipal and industrial wastes. Impoundments also have a significant effect on the dissolved oxygen level.

High water temperatures (above 68^{o} F, 20^{o} C) in the lower Columbia and Lower Snake Rivers and several coastal streams have deleterious effects on anadromous fish.

Nitrogen supersaturation, which results from spills over dams, is a serious problem throughout the Lower Snake and Columbia Rivers. High temperatures seem to magnify its effect. A special study is underway to determine the reason for its persistence in the river, its lethal limits and possible solutions.

Aquatic growths which can cause taste and odor problems, clog irrigation canals, fish nets and lines, reduce aesthetic appearance, and depress dissolved oxygen levels, occur in a number of areas. The Snake River and lower Columbia River are examples of this problem.

Algae growths are sometimes a problem in a few reservoirs. The American Falls, Brownlee, Long Lake, and Fern Ridge reservoirs are examples of water bodies where this has occurred.

A few stream reaches, notably in the Clark Fork and South Fork Coeur d'Alene Rivers, have been rendered biologically sterile by the discharge of heavy metals from mining operations.

The volume of streamflow is also an important factor affecting water quality. Occurrence of low flows critical to quality control results from natural low water conditions and in some instances to the management regimen of upstream storage. The Spokane River, Yakima River, Snake River below Milner Dam, and lower Malheur River, as well as many small streams, are examples of streams that experience critical low flows. Low flows are frequently the result of withholding water in storage or the actual diversion of a significant part of a stream. Reservoirs in the region do not have storage specifically allocated to water quality control. Although there are no authorized means of managing streamflow in response to pollution problems or water quality requirements, streamflow provided for other purposes is often of considerable assistance in improving water quality.

Diversions

Surface water diversions equal approximately 10 percent of the total regional discharge. These diversions serve a variety of purposes of which irrigation accounts for about 95 percent. Irrigation, together with industrial and rural-domestic uses, requires over 36 million acre-feet annually. Diversions are also made for hydroelectric power, waste dilution, and, to a limited extent, for fish hatcheries, recreation, and waterfowl and game habitat.

Irrigation

In 1970, 33.7 million acre-feet of surface and ground water were diverted to irrigate the 7.5 million irrigated acres. Return flows amounted to 17.9 million acre-feet, resulting in a net depletion of 15.8 million acre-feet. About 90 percent of the diversions came from surface sources (including storage) and the remaining 10 percent from ground water. Some 2.0 million acres are subject to shortages which averaged about 2.2 million acre-feet. Estimated water use for 1970 is shown on table 28.

Municipal and Industrial Water

The annual withdrawal of water for municipal use is estimated to be 1.1 million acre-feet annually, for industrial use, 2.1 million acre-feet, and for rural-domestic and livestock over 0.2 million acre-feet. The major water demand for these uses is in the area west of the Cascades.

Some 829 municipal water supply facilities in the region furnish water to over 4.5 million people. Heavily populated Subregion 11 (Puget Sound) has a municipal use of 303 mgd, or 33 percent of the region's total. Subregion 9 (Willamette Basin) accounts for nearly 25 percent.

Total industrial water use is about 1,920 mgd. The pulp and paper industry is the largest water user with 934 mgd or nearly half of the total industrial requirement. The primary metals, food processing, lumber and wood products, and chemical products industries are also major users. Over 70 percent of this total water use is concentrated in the region's 34 major service areas.

In general, industries have developed adequate independent water supplies, although a number of food processing firms obtain water from municipal facilities. In the western subregions, water supplies are most often from surface sources. The largest water using industries in the eastern subregions generally depend on surface sources, but most smaller ones use ground water.

Rural-domestic water use, which includes stock watering and small scale irrigation, approximates 210 million gallons per day. About two-thirds are used for the rural population and the remainder for livestock watering.

Ground Water

Total annual ground-water withdrawal is estimated to be about 5.0 million acre-feet as of 1970, of which about 3.6 million acre-feet (76 percent) are for irrigation and 1.4 million acre-feet are for industrial use and public water supply.

Ground-water withdrawal is summarized by type of use and subregion in table 16. Irrigation use is by far the greatest in subregions east of the Cascade Range and the greatest concentration of use is in the Snake River Basin (Subregions 4 and 5). There is also considerable withdrawal for irrigation in the Willamette Valley (Subregion 9).

Industrial supplies include only self-supplied industrial withdrawals. The greatest concentration of ground-water withdrawal for self-supplied industrial use is in the Vancouver-Camas area and the Willamette Valley (Subregions 8 and 9). Public supplies are utilized for domestic, commercial, industrial, and other uses. Ground-water withdrawals for public supply are fairly well distributed through the region, but withdrawals are greatest in the Spokane Valley and the Puget Sound area (Subregions 1 and 11). Total annual consumptive use of ground water is estimated to be about 2.4 million acre-feet as of 1970, of which nearly 90 percent is by irrigation

Table 16 - Summary of Ground-Water Withdrawal by Use and Subregion, 1970
Columbia-North Pacific Region

Type of Use	1	2	3	4	5	6	7	8	9	10N	10S	11	12	Region
						(1,000 ac-ft)								
Municipal	117	36	27	61	49	25	30	22	69	2	16	51	2	507
Industrial	137	33	25	96	35	2	12	115	108	6	20	31	2	622
Rural Domestic	28	21	20	34	30	11	10	10	21	4	13	11	4	217
Irrigation	137	410	80	2,096	211	35	191	9	239	10	2	97	44	3,561
Fish & Widlife	1	1	-	3	-	-	1	3	-	-	-	-	8	17
Total	420	501	152	2,290	325	73	244	159	437	22	51	190	60	4,924

Source: Appendixes IX, Irrigation; XI, Municipal & Industrial Water Supply; and XIV, Fish and Wildlife.

In most of the region the ground water that is withdrawn but not consumed either discharges into fresh surface water bodies or percolates into aquifers. Exceptions are in Subregions 10 and 11 where part of the unconsumed ground water discharges into the Pacific Ocean or Puget Sound. Thus, depletion of the total annual water yield of the region by ground-water withdrawal is little more than annual ground-water consumptive use. However, as only part of the unconsumed ground water returns to aquifers, net ground-water withdrawal (consumptive use plus return to surface water bodies) is considerably larger than consumptive use alone.

Net ground-water withdrawal was estimated to be between 3 and 4 million acre-feet a year as of 1970, or 3 to 4 percent of net annual recharge. However, most of this withdrawal is from the major aquifers, which have a total gross annual recharge and discharge of about 78 million acre-feet. Some ground water also cycles through these aquifers more than once before leaving the region, especially in Subregion 4, and net annual recharge and discharge of these aquifers may be about 70 million acre-feet a year. Thus, net ground-water withdrawal is 4 or 5 percent of net annual recharge to and discharge from the major aquifers.

LAND USE AND MANAGEMENT

Through its various land-management agencies, the Federal Government manages more than 95.5 million acres or 55 percent of the regional land area. The Forest Service and the Bureau of Land Management are the principal managing agencies. Private individuals and corporations own almost 40 percent, the balance being held by state, county, and local governments. Table 17 lists the ownership in detail.

Table 17 - Land Ownership Acreage, 1965
Columbia-North Pacific Region

Administering Agencies	Idaho	Montana	Nevada	Oregon	Utah	Washington	Wyoming	Total
				(1,000 ac)				
Department of Agriculture								
Forest Service	19,790.2	8,736.9	675.5	13,866.7	46.7	9,016.0	2,274.2	54,406.2
Other Agriculture	32.7	-	-	14.6	-	.4	-	47.7
Total	19,822.9	8,736.9	675.5	13,881.3	46.7	9,016.4	2,274.2	54,453.9
Department of the Interior								
Bureau of Land Management	11,839.4	152.3	1,871.5	15,313.6	52.4	275.2	13.0	29,517.4
Bureau of Indian Affairs 1/	831.1	618.8	144.3	690.0	-	2,507.8	-	4,792.0
National Park Service 2/	84.9	655.7	-	64.4	-	1,903.0	686.1	3,394.1
Fish & Wildlife Service	20.2	20.4	-	433.3	-	110.0	24.6	608.5
Bureau of Reclamation	581.8	.4	-	160.9	-	393.0	-	1,136.1
Other Interior	.1	.1	-	2.7	-	7.1	-	10.0
Total	13,357.5	1,447.7	2,015.8	16,664.9	52.4	5,196.1	723.7	39,458.1
Department of Defense	94.0	.1	-	148.6	-	504.3	-	747.0
Other Federal	575.1	.3	-	3.3	-	381.0	-	959.7
Total Federal	33,849.5	10,185.0	2,691.3	30,698.1	99.1	15,097.8	2,997.9	95,618.7
State	2,745.6	646.0	-	1,710.4	25.7	3,315.6	9.0	8,452.3
County	105.2	2.4	-	282.9	-	96.9	-	487.4
Municipal	40.0	7.1	-	137.7	-	293.3	-	478.1
Total Public Non-Federal	2,890.8	655.5	-	2,131.0	25.7	3,705.8	9.0	9,417.8
Total Public	36,740.3	10,840.5	2,691.3	32,829.1	124.8	18,803.6	3,006.9	105,036.5
Total Private	14,044.8	5,081.1	605.2	24,731.5	116.1	23,872.0	228.1	68,678.8
Grand Total	50,785.1	15,921.6	3,296.5	57,560.6	240.9	42,675.6	3,235.0	173,715.3

1/ Private lands held in trust by the Federal Government.
2/ Updated to 1969.
Source: Appendix IV, Land & Mineral Resources.

Indian tribal and allotted lands total nearly 4.8 million acres, both inside and outside Indian Reservations. These areas are owned by the individual Indians or tribes with trust responsibilities vested in the Bureau of Indian Affairs. The states own nearly 8.5 million acres. Of the seven states, only Nevada does not own land in the region. Management is spread among many state agencies. In most states, the Natural Resource or Forestry Departments, Park, Fish and Game, and Highway Departments have principal responsibilities.

The categories of present cover and land use are set forth in table 18 by ownership, states, areas, and subregions.

Table 18 - Cover and Land Use, 1966
Columbia-North Pacific Region

Ownership & Location	Cropland	Forest Land	Rangeland	Other Land	Total
			(1,000 ac)		
Ownership					
Department of Agriculture					
Forest Service	-	45,727.3	6,677.6	2,001.3	54,406.2
Other Agriculture	.4	-	46.8	.5	47.7
Total	.4	45,727.3	6,724.4	2,001.8	54,453.9
Department of the Interior					
Bureau of Land Management	-	4,486.6	24,275.9	754.9	29,517.4
Bureau of Indian Affairs 1/	364.1	2,658.3	1,635.7	133.9	4,792.0
National Park Service	-	2,503.9	255.7	634.5	3,394.1
Fish & Wildlife Service	28.5	64.2	373.1	142.7	608.5
Bureau of Reclamation	14.0	17.0	1,033.5	71.6	1,136.1
Other Interior	-	-	-	10.0	10.0
Total	406.6	9,730.0	27,573.9	1,747.6	39,458.1
Department of Defense	-	83.4	459.6	204.0	747.0
Other Federal	-	2.3	946.3	11.1	959.7
Total Federal	407.0	55,543.0	35,704.2	3,964.5	95,618.7
State	247.4	4,341.3	3,111.8	751.8	8,452.3
County	-	227.0	-	260.4	487.4
Municipal	-	222.6	3.6	251.9	478.1
Total Public Non-Federal	247.4	4,790.9	3,115.4	1,264.1	9,417.8
Total Public	654.4	60,333.9	38,819.6	5,228.6	105,036.5
Total Private	20,149.4	25,509.6	19,925.0	3,094.8	68,678.8
Total Land Area	20,803.8	85,843.5	58,744.6	8,323.4	173,715.3
States					
Idaho	5,988.5	20,901.0	21,998.5	1,897.1	50,785.1
Montana	843.4	12,708.0	1,370.4	999.8	15,921.6
Nevada	155.1	106.0	3,012.4	23.0	3,296.5
Oregon	5,347.9	27,479.6	22,521.9	2,211.2	57,560.6
Utah	8.2	25.9	203.6	3.2	240.9
Washington	8,304.6	22,970.0	8,522.2	2,878.8	42,675.6
Wyoming	156.1	1,653.0	1,115.6	310.3	3,235.0
Total	20,803.8	85,843.5	58,744.6	8,323.4	173,715.3
Area A					
Subregion 1	1,552.1	18,242.1	1,698.1	1,327.1	22,819.4
2	3,308.8	5,652.1	4,583.9	536.0	14,080.8
3	686.3	1,508.9	1,534.8	121.4	3,851.4
Total	5,547.2	25,403.1	7,816.8	1,984.5	40,751.6
Area B					
Subregion 4	3,781.3	4,296.9	13,555.8	1,047.8	22,681.8
5	1,628.9	4,190.5	16,838.7	739.4	23,397.5
6	3,077.8	13,537.1	5,041.8	714.5	22,371.2
Total	8,488.0	22,024.5	35,436.3	2,501.7	68,450.5
Area C					
Subregion 7	3,570.6	8,328.3	6,358.1	565.2	18,822.2
9	1,456.1	5,272.0	58.8	815.9	7,602.8
10S	423.0	10,155.0	114.0	293.0	10,985.0
12	365.0	1,893.0	8,733.1	403.7	11,394.8
Total	5,814.7	25,648.3	15,264.0	2,077.8	48,804.8
Area D					
Subregion 8	201.1	2,665.0	67.9	258.6	3,192.6
10N	161.8	3,673.6	54.6	179.2	4,069.2
11	591.0	6,429.0	105.0	1,321.6	8,446.6
Total	953.9	12,767.6	227.5	1,759.4	15,708.4
Region	20,803.8	85,843.5	58,744.6	8,323.4	173,715.3

1/ Private lands held in trust by the Federal Government.
Source: Appendix IV, Land and Mineral Resources.

Cropland

Nearly 21 million acres, or 12 percent of the land in the region, are used as cropland. Of this total, over 13 million acres are under dryland management and over 7 million acres are presently being irrigated. Small grain crops occupy from a third to a half of the cropland, except along the western coastal edge. In the coastal subregion, over two-thirds of the cropland is occupied by forage crops. Orchards occupy nearly ten percent of the cropland in the Willamette Valley in Oregon and in the central Washington valleys. They are generally irrigated in the latter area. Another large irrigated area in central Washington, the Columbia Basin project, contains row crops, hay, and seed crops. In the remainder of the Columbia Plateau, much of the cropland is fallow with grain the principal crop. Nearly half of the row crops, including vegetables, potatoes, sugar beets, and corn, are concentrated in the Snake River Plains in Idaho. Nearly half of the region's irrigated land is located in southern Idaho.

Forest Land

The region contains 85.8 million acres of forest land (11 percent of the Nation's total) of which 70.4 million acres are commercial forest land. Of the 15.4 million acres of non-commercial forest land, 5.1 million acres are of commercial character but are in areas reserved as national parks, wilderness and primitive areas, and state, county, and municipal parks. The remaining 10.3 million acres of noncommercial forest lands are unsuitable for raising commercial timber crops.

National forests are the largest public forest land holding with 51 percent (36 million acres) of the commercial forest area of the region. Public Domain, Oregon and California Revested Lands, and Indian landowners account for 7 percent (5.3 million acres) of the commercial forest land. Other public owners include the states, counties, and municipalities which, as a group, account for 4.4 million acres of commercial forest land.

Private owners hold 24 million acres or 34 percent of the commercial forest land in the region. Industrial forest owners manage 55 percent, 13.2 million acres, of private commercial forest land. Lumber companies are the most important industrial ownership with 4.6 million acres of commercial forest land; pulp and paper companies rank second with 2.4 million acres. Farmers own 2.5 million acres, mostly in small holdings, of the commercial forest land whereas miscellaneous private ownerships, such as railroad ownership, are large and are actively managed for timber production.

The region's 70.4 million acres of commercial forest land represent 14 percent of the Nation's commercial forest area. However, this is 42 percent of the Nation's forest land rated as potentially most productive (about 18 million acres). The Columbia-North Pacific Region contains an estimated net volume of 217 billion cubic feet of timber on commercial forest land, nearly one-third of the Nation's total timber volume.

Although timber production is one of the key uses, the forests are equally important for other purposes: source of water, recreation, hunting, fishing, sightseeing, and other outdoor activities.

Rangeland

Rangeland comprises 58.7 million acres, or slightly less than 34 percent of the total regional area. These lands provide 7.3 million animal unit months (AUM's) of livestock grazing annually. Public land contributes a little more than 4.3 million AUM's and private rangeland accounts for 3.0 million AUM's.

Forage is used primarily for grazing livestock (cattle, sheep, and horses), but it is also used by many species of wildlife.

The principal Federal management agencies involved in the administration of rangeland are the Bureau of Land Management, which is responsible for 41 percent of the total area concentrated in the eastern subregions, and the Forest Service, with approximately 11.5 percent of the total scattered throughout the region. Private owners control about 34 percent, mostly in the eastern part of the region.

The combination of overgrazing and range fires in early periods caused many range areas to be in poor condition. In recent years the application of good management practices, including fire control, has resulted in an upward trend in most areas. Continued effort is being made by both the private and public land managers to improve range conditions, but considerable work remains to be done.

Other Land

The high alpine areas of bare rock peaks, such as the Rocky Mountains, and areas of lava flow mostly related to the Columbia River Basalt are highly important from the standpoints of water production and esthetic values. Another increment of other land is the small water areas of less than 40 acres and streams less than one-eighth mile wide. The number of small water impoundments

will increase as the population and irrigated areas increase. Thus, barren areas (over 5 million acres or almost 3 percent) plus small water areas (almost 0.5 million acres or almost 0.3 percent of the land area), together equal almost 6 million acres, or 3 percent of the region, and are significant mainly for water supply or esthetics.

The balance of the other land is occupied by roads, farmsteads, urban and industrial areas, and similar uses. Table 19 shows the amounts of the major categories of other land use.

Table 19 - Other Land, 1966
Columbia-North Pacific Region

State	Barren	Roads & Railroads	Small Water 1/	Miscellaneous 2/	Total
			(1,000 ac)		
Idaho	1,515.4	163.7	36.5	181.5	1,897.1
Montana	737.9	92.4	51.8	117.7	999.8
Nevada	8.0	4.1	10.3	.6	23.0
Oregon	1,052.1	225.1	202.9	731.1	2,211.2
Utah	2.8	.2	.1	.1	3.2
Washington	1,424.6	375.3	133.3	945.6	2,878.8
Wyoming	276.0	8.7	15.0	10.6	310.3
Total	5,016.8	869.5	449.9	1,987.2	8,323.4
Percent	60.3	10.4	5.4	23.9	100.0

1/ Water areas less than 40 acres in size and streams less than one-eighth mile in width.
2/ Includes urban and industrial areas, farmsteads, airports, and other areas.
Source: Appendix IV, Land and Mineral Resources.

Wildlife Habitat

The varied climate and topography provide habitat suitable for a wide variety of big game, upland game, waterfowl, and others, some native, some introduced.

All of the states in the Columbia-North Pacific Region have agencies charged with the management of the wildlife resources. As these agencies do not control non-Federal land, cooperative agreements are made with private landowners for management benefiting wildlife. On public lands, various legal and administrative rules apply; but, in general, the wildlife agencies guide land developments that will result in the least

damage to wildlife. Public and private lands are usually not managed exclusively for wildlife. These uses must be fitted into the major management objective of the landowner or administrator.

There are, however, scattered throughout the region, lands that are administered by State and Federal wildlife agencies and managed exclusively for the benefit of wildlife. These lands comprise 36 national refuges totaling some 642,000 acres and 100 state wildlife management areas with a total of 778,000 acres.

PROJECTED ECONOMY AND LAND USE

P R O J E C T E D   E C O N O M Y   A N D   L A N D   U S E

POPULATION, EMPLOYMENT, AND INCOME

The baseline economic projections for the Columbia-North Pacific Region were developed as part of a national-interregional projections program (OBERS) of the U. S. Water Resources Council in March 1968. Projections of population, income, employment, and demand for agricultural and forestry goods and services were made both for the United States and for each Water Resource Region. Within this framework, economic projections for the principal resource industries--agriculture, forest industries, and mining and primary metals--were developed.

Projections of the major components of economic growth are shown in table 20. Explicit assumptions concerning fertility rates, employment-population ratios, gross national product and the general national and international environment which directly affect these projections are discussed in Appendix VI, Economic Base & Projections. For the purposes of this study, the projections for the Willamette Basin Type 2 and the Puget Sound & Adjacent Waters studies were substituted for OBERS projections for Subregions 9 and 11. Each of these projections utilizes different assumptions and methodologies than OBERS for the same geographic areas. A comparison of these economic projections is made in the Addendum to Appendix VI, Economic Base & Projections.

Approximately 69 percent of the region's 1970 population of 6.4 million was concentrated west of the Cascade Range. Population growth has followed the national distribution patterns with increasing urban, decreasing rural farm, and relatively stable rural nonfarm concentrations.

Future growth in population will be dependent upon economic development and is projected to increase from 5.4 million in 1960, to 15.4 million in the year 2020 (table 20). The Willamette and Puget Sound Subregions are projected to have annual rates of growth significantly greater than those of the region. Approximately 75 percent of the regional population is projected to be located west of the Cascade Range by 2020.

Total employment is estimated to increase from about 2.0 million in 1960, to 5.1 million in 2020. Employment, like population, will likely be concentrated in the western portion of the region. Annual growth in employment during the next 50-year period is projected to be 1.8 percent.

Table 20 - Population, Employment, and Income, 1960, with Projections for 1980, 2000, and 2020
Columbia-North Pacific Region

Item	1960 1/	1980	2000	2020	Average Annual Trends 1960-1980	1980-2000	2000-2020	1980-2020
		(thousands)				(percent)		
Projections by OBERS 2/								
Population	5,426	7,294	9,710	12,680	1.5	1.4	1.3	1.4
Employment	1,979	2,869	3,866	5,067	1.9	1.5	1.4	1.4
Personal Income (1958 dollars)	12,981,737	29,881,702	68,563,235	154,437,238	4.7	4.2	4.1	4.2
Total Earnings (1958 dollars)	9,558,311	23,263,268	51,681,849	114,560,277	4.3	4.1	4.1	4.1
Projections by OBERS as modified with Type 2 Projections 3/								
Population	5,426	7,611	10,690	15,395	1.7	1.7	1.8	1.8
Employment	1,979	2,835	3,999	5,700	1.8	1.7	1.8	1.8

1/ Data for income, 1962, and earnings, 1959-
2/ Projections developed on March 1969 by the Office of Business Economics Department of Commerce and the Economic Research Service, Department of Agriculture (OBERS).
3/ OBERS projections adusted by the substitution of the Willamette and Puget Sound Type 2 projections for Subregions 9 and 11, respectively.
Source: Appendix VI, Economic Base and Projections.

Total personal income for the region is projected to increase at a rate slightly higher than the national rate. Per capita income in the region has compared favorably with the national average. Regional per capita income exceeded the national level each of the census years 1940, 1950, and 1960. Regional per capita income in 1962 was $2,325 with total personal income amounting to $12.98 billion (in 1958 dollars).

ECONOMIC DEVELOPMENT

The basic characteristics of the economy of the region are similar to that of the Nation. In 1960, noncommodity-producing industries included 68 percent of the total employment of about 2 million. At the national level, approximately 65 percent of total employment in 1960 was associated with noncommodity-producing industries.

The major water-consuming industry is agriculture. In 1965, about 95 percent of all water withdrawals and 95 percent of water consumed were for irrigation in the region. Thus the projected needs for irrigation become highly important in planning for water resources development.

Projections of employment and production have been made for all industries. Details are found in Appendix C, Economic Base of the Willamette Type 2 Study, in Appendix IV, Economic Environment of the Type 2 Study of Puget Sound & Adjacent Waters, and in Appendix VI, Economic Base & Projections, of this study. Selected data and projections are summarized below by industry categories.

Noncommodity Industries

About 1,290,000 employees were engaged in noncommodity industries in 1960. Employment in these industries is projected to triple by 2020. These service industries do not rely directly on resources of the area and are relatively low consumers of water.

Sales of wholesale, retail, and selected services establishments during 1963 were concentrated in Subregions 8, 9, and 11. These three subregions, comprising the Willamette-Puget Sound Trough, experienced sales of $13.1 billion, or 67 percent of the regional total for these industries.

Forest Related Industries

Forestry, lumber and wood products, and paper and allied products are three highly important industries. In 1960, they

employed about 180,000 employees. Over the next 50 years, forest industry payrolls are projected to more than double in the same period while the number of manufacturing employees declines. This increase in payrolls will be associated in large part with a substantial increase in forest management employment.

Agriculture and Related Industries

The projected national demand for food and fiber and meeting a substantial share of this demand in the region are major factors in the need for water and land resource development.

In 1964 the value of agricultural commodity production exceeded $1.5 billion.1/ Approximately 60 percent of this value was from crops and 40 percent from livestock and poultry. More than 150,000 persons were employed in agriculture during 1964. Wheat is the major cereal and its production is concentrated in the Columbia Basin area and southeastern Idaho. Production of small grains was over 6 million tons in 1964 and its value exceeded $332 million. Other major crops, in terms of value, are fruits, nuts, and berries; the value of these crops was over $152 million in 1964. Beef and veal production was over 1.4 billion pounds in 1964 and its value about $284 million. The production of cattle and calves (beef and veal) is distributed throughout the region. Large scale cattle ranching is generally located in subregions east of the Cascade Range.

The total value of agricultural production is projected to more than double by 2020.2/ This increase would be achieved largely by irrigation development, cropping pattern changes, and increased yields through greater use of technology and other capital inputs.

Values of both crop and livestock production are projected to more than double. The largest relative increase in crop production (more than three times by 2020) is projected for sugar beets, potatoes, vegetables, and fruits (table 21). By 2020, study projections show a decrease to 90,000 employees.

1/ Economic Base & Projections, Appendix VI. Table 27, page 59.
2/ Op. Cit., Table 29, page 64.

Table 21 - Production of Agricultural Commodities, 1964, with Projections for 1980, 2000, and 2020, Columbia-North Pacific Region

Commodity	Unit	Production			
		1964 1/	1980 2/	2000 2/	2020 2/
		(thousands)			
Small grains 3/	tons	6,096	9,700	10,700	11,800
All hay	tons	7,747	11,800	15,300	20,900
Dry beans	cwt.	6,834	8,500	10,100	12,300
Sugar beets	tons	4,588	9,000	14,000	20,300
Potatoes	cwt.	55,419	128,000	168,000	220,000
Vegetables	cwt.	20,464	33,900	44,200	57,000
Fruits nuts, & berries	tons	1,258	2,100	2,800	3,700
Forage seed, hops & mint	lbs.	407,222	504,000	656,000	852,000

1/ Estimated from Census of Agriculture and Statistical Reporting Service data.
2/ Appendix IX, Irrigation.
3/ Small grains include wheat, oats, barley, rye, and corn.

Manufacturing Industries

Manufacturing comprises petroleum, chemicals and allied products, primary metals, and other manufacturing. Employment in 1960 of about 278,000 persons is expected to triple by 2020. A large percentage of employees in these categories is now located in the Willamette-Puget Sound Trough areas.

The industries listed, except for "other manufacturing", are projected to hold about even in employment over the next 50 years. But "other manufacturing" are projected to increase by one-third by 2020. This "other manufacturing" category comprises several activities including textiles, apparel, printing and publishing, fabricated metals, and machinery and equipment.

Employment in the food and kindred products industry is projected to increase from 58,903 employees in 1960 by two to three thousand by 2020. Whole output is projected to triple.

Mining

In 1965, mineral production was valued at $105 million in Idaho, $86 million in Washington, $81 million in Oregon, and approximately $101 million in western Montana. Industrial mineral

operations are found in all 12 subregions. Production of commodities such as sand and gravel and stone totaled 103 million tons in 1965 and was valued at $125 million. Metals such as copper, lead, zinc, and silver comprised 43 percent of the total value of mineral production that year.

Land Resources and Use

Population growth will increase demand on the land and water resources for food, fiber, transportation, recreation, and related uses.

Cropland use is projected to increase by 4 percent from 1966 to 2020 while food and fiber needs will more than double (table 22). This increase in land will be accompanied by more intensive land use, improved management, increased production, and additional irrigation.

Although existing cropland comprises less than 12 percent of the total land area, additional areas of land are available which are suitable for cultivation and crop production.1/ About 51 million acres of land have been classified suitable for crop production, however irrigation is necessary on much of the land to make it productive.

Forest land is projected to decrease slightly to 84.2 million acres by 2020. Forest and wood-using industries are estimated to require nearly 5.3 billion cubic feet of raw material per year by the year 2020. A substantial increase over the present regional consumptive rate of 4.3 billion cubic feet per year is anticipated through more intensive use of the forest resource.

Rangeland is projected to decrease from 58.7 million acres to 56.5 million by 2020. Livestock production is an important economic activity and livestock grazing is a significant use of the rangeland. Big game animals and other wildlife are also extensive users of this land. Considerable acreage now used for rangeland will likely be diverted to cropland, urban, and other land uses.

1/ Appendix VIII, Land Measures and Watershed Protection.

Table 22 - Cover and Land Use, 1966 with Projections for 1980, 2000, and 2020, Columbia-North Pacific Region

Type	Year 1966	1980	2000	2020
		(1,000 ac)		
Cropland	20,804	21,552	21,407	21,642
Forest Land	85,844	85,416	84,795	84,160
Rangeland	58,745	57,309	57,089	56,461
Other Land	8,323	8,954	9,708	10,488
Total Land	173,716	173,231	172,999	172,751
Water Areas	1,909	2,394	2,626	2,874
Total Area	175,625	175,625	175,625	175,625

Source: Appendix IV, Land & Mineral Resources; Appendix VI, Economic Base & Projections.

The acreages devoted to other land uses are projected to increase more than 2.0 million acres to 10.5 million acres by 2020 (table 22). Projections indicate that the larger population will require an additional 709,000 acres for urban, industrial, farmsteads, airports, and similar uses by 2020. Additional acreage will also be needed for rural nonfarm dwellers and for water storage areas for flood control, irrigation, power, navigation, wildlife, municipal, industrial, and recreational needs.

NEEDS

N E E D S

In order to estimate the future demands expected to be placed on regional land and water resources, it was necessary to translate the economic and land use projections into functional requirements. Comparison of these requirements with available resources, and their current capacity and use indicates the additional management and development needed.

The current use and future needs developed in the functional appendices are summarized in this section.

PRESERVATION AND ENHANCEMENT OF THE ENVIRONMENT

General

The Columbia-North Pacific Region is endowed with a wealth of natural environmental resources, comprising a harmonious combination of spectacular scenery, natural wonders, man-developed landscapes, and economic activities. The natural resources are accessible through a network of highways. Forest and mountain trails tap primitive and wilderness reserves.

Mountains either dominate or constitute the background for almost every landscape. In sharp contrast to the mountains are the lowlands of the Willamette-Puget Sound Trough, the broad plains along the Snake River, interior valleys, sea-facing lowlands, and the high, dry plateaus east of the Cascades. Glaciation, erosion, and volcanism are illustrated by gorges and canyons of the Columbia and Snake Rivers, and by Crater Lake, which is on the edge of the region.

Water shares an equal role with land in scenic and recreation resources. The Pacific Ocean, with a coastline of sandy beaches, coves and rugged headlands, outlines the western boundary of the Northwest. The sheltered waters of island-dotted Puget Sound provide 2,500 square miles of an almost landlocked sea. A multitude of lakes range from alpine ponds to larger bodies such as Flathead, Pend Oreille, Chelan, and Coeur d'Alene lakes.

The Columbia River system is the greatest unifying factor in a region otherwise characterized by great diversity in natural features. The Columbia provides an artery of transportation

running transverse to the north-south alignment of the major mountain barriers.

The Columbia River rises in a mountain lake on the west slope of the Canadian Rockies, 2,650 feet above sea level. It flows northwestward through one of the trenches which marks the northern Rocky Mountain system, cuts through into an adjacent trench, and then courses southward. After entering the United States near the northeastern corner of Washington, the Columbia crosses that state in a series of big bends, then takes its final westward course in a gorge through the Cascade Range.

The Columbia's major tributary, the Snake River, is about 1,000 miles long and drains about 110,000 square miles, or approximately half the United States' portion of the Columbia River Basin. The Clark Fork and Kootenai Rivers, which drain most of western Montana and northern Idaho join the Columbia in Canada. Other major tributaries are the Spokane, Yakima, Deschutes, Willamette, John Day, and Cowlitz Rivers. Other streams discharging into the Pacific in Washington and Oregon and those emptying into Puget Sound are small in comparison with the Columbia. Considering the size of their drainage basins, however, they have high annual flows.

Fish and wildlife resources of anadromous fish, resident fish, marine fish, and shellfish, big game, upland game, fur animals, waterfowl, and other wildlife are significant to man's enjoyment and to the economy. These fish and wildlife populations are dependent upon the habitat provided by practically all the land and waters of the region. Fish are stocked in streams, lakes, and reservoirs from fish hatcheries. Wildlife is protected and managed on 136 refuges and management areas totaling nearly 1.5 million acres. These areas provide public hunting and opportunities to see and photograph wild animals in their natural habitat.

The Northwest has 41 national forests covering 54.4 million acres, supervised by the Forest Service. Recreation is recognized in the administration of the national forests, and numerous campsites, picnic grounds, and sanitary facilities have been established for public use.

A network of trails appealing to the hiker is maintained. Chief among the trails is the Pacific Crest Trail System stretching from Canada to Mexico. Routed along the crest of the Cascades, it leads to points of scenic beauty accessible only by pack horse or foot.

There are 29.5 million acres of land under jurisdiction of the Bureau of Land Management. Outdoor recreation is encouraged

on all lands; but lack of development, access, and public awareness has limited use primarily to activities such as sightseeing, hunting, fishing, and rock hounding. In 1968, there were 81 developed recreation sites, many of which offer water-related recreation opportunities.

The National Park Service administers seven natural areas, three national recreation areas, five historical areas, and a portion of two additional natural areas of the National Park System. These three classes of areas include national parks, national monuments, national historic sites, national historical parks, national memorials, and national recreation areas, all of which are administered under a national policy of preserving the outstanding examples of the Nation's natural and historical resources for the benefit and enjoyment of the people. The Service administers the National Landmarks Program which encourages preservation of natural and historical properties under other ownerships. Some 54 sites in the region have been declared eligible for Registration as a National Landmark. In addition, the Service assumes the leadership role in historic preservation under the authority of the Historic Sites Act of 1935 and the National Historic Preservation Act of 1966. These acts provide for preservation for public use of historic sites, buildings, and objects of significance, encourage preservation by private individuals, and assist State and local governments in preservation programs.

The Bureau of Reclamation has 70 recreation areas developed at 50 reservoirs and some small seep-lakes. These areas experienced nearly 9.5 million visitor-days during 1971. The Corps of Engineers has developed more than 170 camping, picnic, and access areas at 22 reservoirs. These areas were utilized by more than 12 million visitors during 1970.

The northwest states control 376 recreation areas, 90 percent of them scattered through Oregon and Washington. Oregon has the distinction of having the greatest number (232) of state parks in the Nation. State highway departments have maintained a series of attractive picnic spots along principal roads. The state park system of Washington includes 18 well-chosen marine parks, chiefly on Puget Sound, for the convenience of the numerous small boat owners. The State of Washington also maintains 35 historical and geological sites. Notable are Ginkgo Petrified Forest, Sacajawea, and Fort Columbia.

Past and present activities of man modify the natural landscape, and some furnish interesting and stimulating recreation outlets. Dams and bridges represent skillful engineering feats. Logging and milling operations, mining and commercial fishing activities, and industrial plants are interesting additions.

Seas of wheat, orchards, brilliant fields of flowering bulbs, irrigated crops, beef cattle, sheep and dairying form an agricultural setting.

The residents of the region have been accustomed to accept their scenic and recreation heritage as part of daily living. Wise policies have preserved much of the scenic beauty in the past while the retention of this high quality environment is a future responsibility. The northwest has the resources to provide a fuller life for its inhabitants in a manner compatible with the preservation of the natural and manmade amenities.

Needs

Although the region has large areas of mountains, plains, and valleys yet undeveloped, the face of the land is constantly changing by urban and industrial growth, forest, and agricultural activities, expansion of transportation systems, and recreational development, as well as through natural processes. With population forecast to more than double by 2020, there is a need to define and implement ways of life that are compatible with the preservation of the natural and manmade amenities and yet provide an acceptable opportunity for earning a livelihood in an environment which will enhance human life.

To assure an adequate supply of land and water resources for future use, measures must be initiated to protect and, in some cases, enhance the quality of the land and water. A full range of outdoor recreation opportunities now exists. Multiple-use is necessary to insure that these opportunities are still available for future generations. There is a need to maintain many streams in their free-flowing state and estuaries in natural condition because of their scenic, esthetic, and natural recreational values. Adequate streamflows for recreation, environmental, and fishery purposes are needed. Low flow augmentation is required on certain streams to enhance fish habitat as well as to improve water quality during summer months. In some cases, upstream storage reservoirs would provide a means for satisfying the need for augmented flows, reducing the adverse effects of floodflows during spawning periods, and controlling and reducing spills over mainstem reservoir projects. Also, emphasis should be placed on watershed restoration.

Wetlands should be retained to preserve habitat for water-fowl and other water-oriented birds and mammals. There is a need to preserve historical areas and areas of unique civic value. Numerous sites should be investigated for this purpose.

Thorough identification of the region's archeological resources would add greatly to the store of scientific knowledge about pre-existing cultures in the Pacific Northwest. Some known sites have already become of doubtful value because of the activities of amateur artifact collectors. State historic plans have been approved for Washington and Idaho. Oregon's plan is under review.

There is a substantial need for a management program of the sea coast estuaries and related shorelands. The large expanses of open, green space along the Columbia River system are an existing resource of great environmental value. Preservation of area along the lower part of the river in a substantially unaltered form would provide rural landscape near a large, growing metropolitan area. The Columbia River Gorge Commission of Washington and Oregon is cooperating in an effort to preserve a part of this area.

Finally, there is a need for governmental planning and public education directed toward retaining environmental quality.

The maintenance and/or enhancement of the region's environment is an integral part of the livability of the region and is equal in importance to other water and related land resources. Some of the elements needed to maintain and enhance the beauty and other esthetic qualities of the environment are:

Establishment of minimum flows on all streams and augmentation where needed to preserve and enhance esthetics, fish and wildlife, and aid in pollution control.

Waste treatment to remove 85 percent of organic wastes from municipal and industrial effluents by 1980, and 90 percent thereafter.

Landscape management and control including removal of old piling from rivers.

Expansion of designated wilderness and primitive areas, and designation of new areas.

Planned development to improve agricultural and forest management of water and land resources, to conserve, and to reduce damage, and to increase efficiency of their use.

Installation of evaporative cooling, cooling ponds, or dry exchange systems in future thermal electric plants to preclude discharge of warm water into stream systems.

Maximum use of existing transmission line corridors to minimize the land requirement for additional construction.

Planned development of future residential, commercial, and industrial growth to insure efficient resource use and greater harmony with the environment and to provide open space, scenic and recreational opportunities within and near large urban areas.

Comprehensive public education programs pointed toward retaining a quality environment.

Preservation, rehabilitation, and enhancement of fish and wildlife habitat and unique, geological, historical, and cultural areas.

Interdisciplinary studies to determine and maintain available options for future change, for either possible development or permanent preservation.

Identify the opportunities for outdoor recreation consistent with minimum modification of the landscape to maintain a natural scenic appearance.

Study streams to determine whether they should be included in state or national systems of recreation rivers.

Consider the consolidation of recreation and scenic programs into scenic parkway along the Columbia River.

Determine proper level of human use of the fragile ecosystems of alpine, desert, and dune areas.

COASTAL ZONE & ESTUARIES

General

The coast of Washington and Oregon contains about 2,837 miles of shoreline, including 1,928 miles facing the inland waters of Puget Sound and the Strait of Juan de Fuca as well as the shoreline of 172 significant islands of the San Juan Archipelago. The Columbia River estuary, lying between Oregon and Washington, provides about 40 miles of tidal shoreline to the above total. The coast is nationally famous for its natural scenic qualities.

AD-A036 571 PACIFIC NORTHWEST RIVER BASINS COMMISSION VANCOUVER WASH F/G 8/6
COLUMBIA-NORTH PACIFIC REGION COMPREHENSIVE FRAMEWORK STUDY OF --ETC(U)
JUN 72 E J GULLIDGE, H H RALPHS, C STEWART

UNCLASSIFIED NL

2 OF 7

AD A036571

Extraordinarily impressive is the wide diversity of the scenic geologic, biological, and recreational resources. Ecological and geological settings provide inspirational rewards and features to stir the imagination. Included are smooth sandy beaches, rugged and massive bluffs, pounding and surging surf, natural sea caves, numerous salt water coves and inlets, estuaries, offshore rocks and reefs, and sand dunes.

The coastline is an area of constant change, whether receding by erosion, advancing by deposition, undergoing submersion, or rising from the water. These alterations in the physiography of the seashore reflect the complexity of the coastal zone's terrestrial foundations and the natural forces which act upon the zone. This complexity is also evident in the variety of plants and animals that are found in the coastal and estuarine areas. The natural elements affect the plants and animals found here. Some have adapted to the shallow waters close to the shore, to the windswept lands near the ocean, or to brackish water at the mouths of streams. In many cases, they have adapted themselves to the combination of living in and out of the water. The plants, the animals, and many other things--the land, the ocean, the wind, the clouds, the rain, the streams that flow into the ocean here and there--compose the coastal zone. The esthetic and recreational values of the coastal zone have proven to have strong attractions for man. Existing recreational facilities are used to capacity during summers and usage at other times of the year is increasing. On many sections of the coast, increasing intensity of developmental activity is indicative of the growing demand for vacation homes, trailer parks, marinas, and other facilities that make the beauties of the coastal zone available. The estuaries have been vital links between ocean commerce and land-bound populations since the beginning of civilization. Cities and industries have developed at convenient transfer points between ocean and land commerce; and the estuaries, by giving protection from ocean storms and waves, have provided most of those transfer points. In recent years the biological importance of the coastal zone and estuaries has been recognized. It is estimated that regions where there is upwelling of deep water containing abundant mineral nutrients, such as occurs off the Washington coast, total not more than one-tenth of 1 percent of the ocean surface, but produce about half of the world's fish supplies.

The estuaries also have proven to be prolific food-producing areas as well as vital links in the life cycles of many marine and anadromous fish and shellfish. Most of these species spend the whole or part of their lives in the estuarine environment while others are dependent on estuaries for vital links in the food chain. Anadromous fish, such as salmon and steelhead, use estuaries as a transition zone in their migrations

between fresh and salt water. Other commercially and recreationally important fish species require estuarine nurture for survival to maturity. Shad and striped bass, for example, spawn in estuaries. Herring, which is the major food for salmonoids also need the estuaries for sucessful spawning. A variety of other fishes are greatly dependent upon estuarine habitat for spawning, rearing, and feeding.

The production of clams, oysters, and crabs for recreational and commercial uses is also important. Hardshell clams are found on open beaches and in the more saline portions of the estuaries, while softshell clams are most frequently found in sandy mud bottoms in the upper tide flats. Dungeness crabs are an important crop for both recreational and commercial harvest. Estuaries are the nursery ground for juvenile crabs which support the offshore commercial fishing as well as the sport and commercial harvest within the estuaries.

The dollar value of marine and shellfish off the Oregon-Washington coast is given by the 1965 commercial harvest. Exclusive of 45 million pounds of anadromous fish, an estimated 111.6 million pounds of marine fish and 27.1 million pounds of shellfish valued at $8.5 million and $6.4 million respectively were sold in the market place. Recreational marine fishing was an estimated 706,000 angler-days with a value of some $3.4 million while about $5.3 million were spent for nearly 1.1 million man-days of shellfishing.

Estuarine mud flats and waters and marsh vegetation provide important wintering, feeding, and resting areas for the many ducks, geese, and swans using the Pacific Flyway. The black brant is seen where eel grass is common, while limited numbers of whistling swans winter in bays. Estuaries also provide habitat to large numbers of shorebirds, including plovers and sandpipers. Mammals include fur bearers such as beaver, mink, muskrat, otter, and nutria, while marine mammals include the harbor seal, sea lions, whales, and porpoises on occasion.

The estuary has a complicated ecosystem; but fortunately, one that is quite resilient, except where grossly abused. Man and his activities exert pressure on the estuaries and the coastal zone by filling of the tidal areas, polluting the land and waters, dredging harbors, constructing roads and buildings, logging, plowing uplands, and changing the character of the rivers. Yet man is relatively unaware of the full impact of all these activities on the coastal zone and its resources. Fortunately, however, this resource yet can be retained in the Columbia-North Pacific Region by implementation of planned control measures.

Efforts to improve management of the coastal zone are underway in both Washington and Oregon. The State of Washington Legislature passed a seacoast management bill which is now effective but will be placed before the voters at the next election along with a bill placed on the ballot by referendum sponsored by the Washington Environmental Council. One bill places control in the state; the other places it at the local level.

The Oregon Legislature enacted Chapter 608, Oregon Laws 1971, creating a Coastal Conservation and Development Commission to prepare a comprehensive plan for the coastal zone which shall reflect a balancing of the conservation and development of the zone's natural resources. In addition, legislative action extended control of alteration activities in the state's waterways to include filling of beds of state waters in a manner similar to previously existing regulation of removal of materials. Also, Chapter 324, Oregon Laws 1969, requires the Governor to establish zoning regulations for land in any county in which there has not been substantial progress as of December 31, 1971, toward zoning all land in the county.

More specific descriptions and definition of the coastal zone and estuaries are given later in this text under the chapter, "Regional Framework Plans and Programs." The Oregon portion and the Columbia River estuary are under Area C. The Washington portion is under Area D.

Needs

As coastal waters are the ultimate recipient of the residual, nonreclaimable fraction of the waste waters from man's activities, waste management systems must be made more effective and new concepts and practices developed. The environment of the narrow coastal margin of the continent must be maintained in a healthy and esthetically attractive condition if it is to continue to satisfy multipurpose requirements.

The coastal zone has developed so rapidly that local governments are experiencing difficulty in planning for orderly growth and in resolving conflicts. The task has been complicated by the lack of knowledge and procedures necessary for formulating sound decisions and by confusion or division of responsibilities among the various levels of government.

Development which involves landfill not only removes valuable estuarine lands from production, but also interferes with production in other areas through modification of circulation patterns. Almost all of the estuaries in the region have been subject to some losses of productive lands through landfill.

Land so withdrawn has been used for port facilities, marinas, industrial sites, vacation home sites, and agricultural purposes, among others.

Sedimentation has been a problem in almost all estuaries with identifiable damage to fish and bottom life. Silting or sedimentation of waterways and estuaries occurs as a natural phenomenon. However, man's activities, chiefly in land use, make substantial contributions to the silt loads of streams, thereby accelerating the silting process in estuaries. On the other hand, the construction of impoundments on streams tends to reduce sand and silt discharges which sustain coastal features, such as sand spits, against wave action. Curtailment of the silt has led to erosion problems. The effects of upstream land and water uses upon the resources and values of estuaries have not been clearly established.

Erosion becomes a problem when it threatens developments or significant natural resources. Out of a total coastal shoreline of 2,837 miles, some 71.3 miles have critical erosion problems while 192.5 miles are subject to noncritical erosion. During the period of historical record, erosion in the State of Washington has been most severe and persistent along the Pacific Ocean coastline. Most of this erosion has occurred near the estuaries of Willapa Bay and Grays Harbor. In Oregon, the Bay Ocean area near Tillamook has been severely eroded.

Local water quality problems cause damage to natural resources in the principal estuaries. Such problems are expected to increase in magnitude and kind with increasing population and industrial development unless adequate counter measures are adopted. Minimum flows are required in streams to maintain the ecological balance of the estuaries. The size of these flows is not known and further studies are needed.

The principal commercial navigation needs are improvements to harbor entrances and the deepening of channels. The need for additional shore facilities would depend on the type of cargo handled and the degree of modernization of port facilities. Through the adoption of improved handling methods, existing port developments may be capable of meeting all ordinary needs of the future. Therefore, the need to withdraw estuarine lands for port developments may be reduced. However, deeper draft ships of the future will require deeper channels. For recreational boating, there is need to both expand and improve facilities. Existing facilities are overtaxed and additional facilities are needed to keep pace with the dramatic increase in small boat usage.

Reclaimed estuarine lands have been used for housing and industrial developments. Demand for land fill for such purposes

is expected to increase, particularly for the construction of vacation homes. However, many of the industries and all vacation homes seeking waterfront locations could, without undue penalty, be located on other than estuarine lands. Waterfront locations are, however, essential to certain industries and estuarine locations for such developments would appear to be justifiable. There is little information available at present as to land requirements of industries which need waterfront locations for their proper functioning.

The needs in estuaries and coastal zones are identified as the protection, preservation, and control of habitat, while at the same time maintaining the values for social and economic pursuits. They differ in some respects from estuary to estuary because of differences in the level of development and the extent and kind of the resource to be protected. The basic institutional means of satisfying needs is to legislate for planning, zoning, and otherwise regulating development and use of estuarine and coastal zones. In addition to enabling legislation, the following is needed:

(1) The preparation and implementation of an interim plan for each estuary and section of coastal zone to regulate developments and protect environmental and scenic values. The plan should include:

(a) The control of the filling of tidelands, marshlands, and submerged lands and structural development in navigable waters.

(b) The safeguarding of important fish and wildlife habitats and their governing ecological parameters.

(c) The evaluation of proposals to dredge or modify navigation channels to establish their effects on shoaling and erosion; and proposals for bulkhead, pier, or wharf construction, to determine their effects on shoaling, erosion, and water quality.

(2) Investigations, including model studies, to seek solutions to erosion, shoaling, and navigation problems and needs including watershed areas.

(3) Hydraulic studies to:

(a) Determine circulation and tidal transport patterns.

(b) Determine sediment loads, deposition, and scouring both within the estuaries and on the ocean front.

(c) Determine flushing patterns and rates.

(d) Improve understanding of interrelationships between fresh and salt water, including the need for minimum flows.

(4) Biological studies of estuaries to:

(a) Determine fish and wildlife habitat areas of primary importance needed to maintain or increase present population levels.

(b) Determine the relationship of intertidal areas to productivity in open waters of estuaries.

(c) Determine seasonal populations of aquatic flora and fauna of different ecological areas of the ecosystem.

(d) Determine the degree to which fin fish, shellfish, and crustaceans and their respective food chains depend upon estuarine water.

(e) Determine rates at which oxygen and key species of animals and plants are produced in various ecological areas of estuaries.

(5) Functional studies of estuaries to:

(a) Determine values of estuaries for fish and wildlife resources, scenic features, environmental quality, open spaces, and recreation.

(b) Determine values of estuaries for navigation, urban and industrial development, and other economic activities.

(6) A coordinated, integrated plan for the management and use of all estuarine and coastal areas based on the findings of the above studies. This plan would give equal consideration to the values identified in those studies, and would include provisions for the protection of important fish and wildlife habitat in conjunction with developmental programs.

FLOOD CONTROL

General

Most major floods on the Columbia River and throughout the area east of the Cascade Range stem from rapid melting of the winter snowpack during late spring and early summer. Such floods rise gradually to a peak and high flows last for a considerable period. The volume can be predicted quite accurately in advance, but as peak flows are highly dependent on current weather phenomena, they cannot be predicted accurately more than a few days in advance. Occasional flooding can be augmented by excessive rainfall during the peak of the snowmelt season. This was especially valid in 1948.

Convective storms accompanied by intense rainfall cause floods in localized areas east of the Cascade Range. Floods of this nature occur somewhere in the region almost every year, resulting in extensive localized damages, but have little effect on major streams.

Widespread, warm, winter rainstorms cause floods east of the Cascade Range in areas generally below 4,000 or 5,000 feet in elevation. Although such floods are not a common occurrence, effects are usually compounded by snowmelt, frozen ground and/or ice in the streams, and severe damages may result.

West of the Cascade Range most floods are caused by rainfall, although floods may be augmented by snowmelt. The floods caused by rainfall peak within a few hours or days, and the flows recede rapidly to within bank stages unless other storms follow causing streams to be at or above flood stage for longer periods. Most major rainfall floods occur between the middle of November and the end of February with peak occurrence in late December and early January. Such floods are frequently preceded by a period of above normal precipitation that thoroughly saturates the ground, and effects may be compounded by snowmelt and frozen ground conditions. Spring freshets from snowmelt occur on streams draining areas above 4,000 to 5,000 feet elevation.

Extent of Flooding

Extent and Frequency The flood plains of the major streams and tributaries, which total nearly 4 million acres, range from brushy marshlands to business and residential districts. Frequency of flooding is also variable, ranging from once every

2 or 3 years to once in a hundred or more years. Although many of these lands have been provided some degree of protection, in many cases the protection is inadequate for present or prospective usage.

All subregions experience flood problems of varying severity. Major damages are encountered on several of the larger streams flowing into Puget Sound and in the Rogue, Umpqua, Tillamook, and Chehalis Basins of Subregion 10. The more serious problems in the Willamette Basin and along the Columbia River below Bonneville Dam have been relieved by existing and under construction structural measures.

Impact of Sediment Load Throughout much of the region, little data have been collected on sedimentation. The available data are shown in Appendix V, Water Resources. Although the average annual sediment yield east of the Cascade Range ranges from 0.02 to 4 acre-feet per square mile, the yield from much of the area is less than 0.1. The largest source is from sheet erosion on dry-farmed agricultural land, and is the most rapid during heavy winter rains on frozen ground and during violent summer convective storms.

West of the Cascades, yields range from 0.1 to 0.5 acre-feet per square mile per year except in the interior Rogue Basin, where yields are down to 0.02. Most of this sediment results from scour in mountain channels, bank erosion on alluvial reaches, and logging or construction work near streams.

Regardless of the locality or source of material, erosion is most rapid during major storms and floods. For example, estimates of sediment transport indicate the December 1964 flood carried three times the average annual sediment transport in the Willamette River at Portland and from 10 to 20 times the annual load in several streams east of the Cascade Range.

Existing Protection

Storage is the most effective means of controlling flood damages on major streams. It prevents overbank damages and reduces instream damages. Local protection projects, such as levees, supplement the effects of storage and also protect areas where storage is not feasible. Watershed treatment practices alleviate damages by minor floods and reduce the amount of sediment carried by major floods. Flood plain regulation is gradually being employed, but not all states have legislative authority to implement such programs on a statewide basis.

Storage Very few exclusive flood control reservoirs have been constructed, but several multiple-use reservoirs have some space reserved exclusively for flood control. In addition, some control of floodwaters is achieved incidental to the use of storage for other purposes. More than 45 million acre-feet of single-purpose and joint-use flood control storage have been provided, and an additional 11.1 million acre-feet in other reservoirs and farm ponds provide incidental control of floodwaters (table 23).

Table 23 - Flood Control Storage, 1970
Columbia-North Pacific Region1/

Sub-region	Allocated Primary	Flood Control Joint Use	Incidental Major Res.	Incidental Farm Pond and Small Res.	Total Storage	Usable for Control of Columbia R. Floods
			(1,000 ac-ft)			
Canada	-	20,900	-	-	20,900	20,900
1	-	10,319	335	38.8	10,693	10,552
2	-	5,232	24	96.6	5,353	5,232
3	-	-	1,071	5.1	1,076	-
4	10	1,716	3,108	50.5	4,885	1,600
5	97	2,270	2,120	97.3	4,584	2,783
6	-	2,000	-	10.9	2,011	2,000
7	8	577	471	9.4	1,065	500
8	100	260	1,850	30.0	2,240	-
9	-	1,703	-	7.2	1,710	-
10	-	65	-	7.3	72	-
11	106	226	1,719	7.2	2,058	-
12	-	-	-	32.8	33	-
Region	321	45,268	10,698	393.1	56,680	43,567

1/ Includes projects under construction.
Source: Appendix VII, Flood Control, and Appendix VIII, Land Measures and Watershed Protection.

Channelization and Levees Local protection projects on major streams include nearly 1,800 miles of levees, 3,500 miles of channel improvements and stabilization, and 3,000 miles of bank protection. About 37 percent of this total mileage is in the Clark Fork-Kootenai-Spokane, and Central Snake Subregions.

Effectiveness of Protection Major flood control projects reduce the total average annual damages in the region by approximately $70 million. The total includes a minor amount for protecting development that would not have located in its present vulnerable position had not protection already been provided. Additional damage reduction is provided by small levees around tidal flats, by the hundreds of miles of channel improvements on small tributary streams, and by the land treatment practices that keep soil out of the streams.

Problem areas have been recognized, and in most instances, nonstructural or structural measures have been provided to curtail remaining and projected damages. Many of the areas still considered to be in the flood plains receive some protection either from reservoirs that partially control floodflows, from local protection projects with limited capability, or from both.

Needs

The flood plains comprise nearly 4 million acres and average annual damages amount to $69.8 million (table 24). Annual damages are projected to increase to $93 million in 1980, $138 million in 2000, and $219 million in 2020. These projections assume that future land use will closely follow existing patterns and that flood damages will be proportional to total development in the flood plains. In urban areas, where value of development closely parallels total personal income, income and population growth parameters have been used for projecting future damages. Rural damages were projected for each flood plain area on the basis of expected productivity of characteristic crops.

Table 24 - Present and Projected Average Annual Flood Damages Columbia-North Pacific Region1/

Sub-region	Flood Plain Area2/ (1,000 ac)	1967 Price Levels3/ ($1,000) 1967	1980	2000	2020
1	315	3,020	3,840	5,300	8,000
2	147	4,550	6,490	10,400	18,300
3	125	1,820	2,390	3,300	5,000
4	584	8,640	11,370	13,900	17,200
5	195	3,770	4,690	5,900	7,700
6	242	5,330	6,840	8,900	11,700
7	165	4,700	5,810	7,600	10,000
8	206	3,760	4,770	7,100	10,800
9	690	5,400	7,100	11,100	20,300
10	437	11,270	15,130	24,500	41,200
11	635	16,060	22,670	37,200	64,100
12	184	1,470	1,980	3,200	4,900
Region	3,925	69,790	93,080	138,400	219,200

1/ If flood plains are not managed or regulated.
2/ Estimated by judgment. Data not available on measured acreage.
3/ Includes major and minor streams and for bank erosion (rounded).
Source: Appendix VII, Flood Control.

Additional details on projected flood damages are given in Appendix VII, Flood Control.

Although the existing flood control program provides considerable protection, the increase in value of developments in the flood plains will continue unless flood plains are regulated to control development. The projected increases in average annual damages are an index of future needs for control of flood damages. Many areas will warrant protection as a result of normal growth, and other areas must be protected to allow for development needed to support an expanding economy. Development may occur in other areas for which the need is not forseen at this time.

Flood Plain Use Regulations

Flood plain regulations are needed to regulate the type and intensity of developments in flood plains and to supplement structural measures where structures do not eliminate all possible hazards. By proper use of zoning, flood proofing, insurance, and other aspects of the program, regulations could assure future use consistent with flood hazards. Regulations are required as early as possible for flood plain areas in and adjacent to growing communities where both flood free and flood plain areas are available for development.

Regulations also are needed to prescribe areas which must be kept free of encroachments to avoid restricting the flow of floodwaters and to establish criteria for flood proofing to minimize damages to buildings and their contents.

Prompt adoption of effective flood plain use regulations would reduce future damages by $1.6 million in 1980, $6.9 million in 2000, and $20 million in 2020.

Flood Forecasting

In this region, long range forecasts as much as 5 months in advance of the Columbia River spring freshet provide guidance for evacuating reservoirs, short range forecasts warn of winter rain and snowmelt floods 2 days to a week in advance, and high storm tide warnings may be issued only a few hours before the event.

Improved techniques, based largely on longer range weather forecasts, are needed. Especially needed are earlier and more reliable forecasts of winter rain and snowmelt floods and floods due to intense convective storms.

LAND MEASURES AND WATERSHED PROTECTION

General

The amount and type of erosion varies throughout the region, depending on land use, type of soil, vegetative cover, slope, and amount and intensity of rainfall. Annual soil losses on cultivated lands are estimated to average 1/16 inch or approximately 10 tons per acre. Excessive winter rains and rapid snowmelt on inadequately protected soils are the major contributors.

Wetness problems on cropland occur on heavy soil and in areas with restricted or impermeable subsurface layers. They result in: (1) decreased production; (2) shortened growing season; (3) restricted land use; (4) limited selection of crops; (5) drowned crops; (6) mosquitos; (7) water pollution; and (8) increased cost of operating farm equipment. However, many wetlands are valuable for wildlife production.

Nearly half of the region is forest land and is located on the steeper slopes where use is limited by the effects of water-caused soil erosion. Management and protection are a continuing need.

Much of the rangeland has been overgrazed and otherwise abused, causing deterioration of plant cover and soil conditions conducive to maximum yields of quality water and forage. Infiltration rates have decreased while peak runoff has increased, causing severe erosion and downstream flood damage.

Urban and industrial growth results in (1) inflation of land values, (2) increased taxes, (3) premature removal of lands from crop production, (4) increased runoff to nearly 100 percent of the precipitation, and (5) destruction of wildlife and fish habitat.

Watershed measures and practices have been developed and applied to reduce erosion and sedimentation, conserve and improve water quality, and alleviate flood damage and wetness problems through a combination of management practices, land treatment, and structural measures. Future changes in land and resources use will influence the requirements to resolve current watershed problems and to provide proper future protection.

Watershed practices applied through 1970 are shown in table 25. These practices vary considerably between areas having differing cover characteristics, climatic and physical features, and type and intensity of use.

Half of the streambank stabilization accomplished has been in forest areas, a fourth in cropland, and a fourth in rangeland areas. Some 91 percent of the dikes have been constructed on cropland and the remainder on rangelands. About 52 percent of the channel improvement is on forested lands, 41 percent in crops and agricultural areas, and 7 percent in rangelands. Nearly two-thirds of the capacity of the ponds and small reservoirs, developed to conserve winter and spring rainfall for subsequent crop and livestock use, are in cropland areas and about a third are rangeland.

Erosion and sediment control practices have been reported on some 7.5 million acres of cropland (49 percent), 7.2 million acres of rangeland (47 percent), and 0.6 million acres of forest land (4 percent). Closely associated with these practices are a number of erosion control structures, about 88 percent of which are in rangeland and others in cropland. They include diversion and detention dams but are primarily small check dams and gully plugs. Identified water conservation practices relate primarily to water management of irrigated cropland.

Protection and management practices cover some 85.7 million acres of forest land and 34.5 million acres of rangeland. These include adjustments in use and location of timber harvest activities and access for watershed protection and rehabilitation, adjustment in grazing use to the grazing capacity of the land, development of water facilities and fences for better grazing distribution and control, provision for adequate fire protection, and reduction of erosion to improve water quality.

Needs

Watershed needs will be affected considerably by demands for more intensive land use and increased multiple-use requirements of land and water resources. Needs for more residential, industrial, transportation, and recreation areas will require an increase of 2.2 million acres (26 percent), in the other land area. Food and fiber demands are projected to increase 113 percent. This is expected to require 800,000 acres of additional cropland, including 84 percent increase in irrigated cropland (7.1 million acres to 13.1 million acres), most of which will be converted from dry cropland. It is estimated that by 2020 large water bodies will increase by 965,000 acres, mostly on present forest and range areas.

The anticipated 1.7 million acres decrease in the forest areas will be mainly commercial forest lands. Despite this decrease in acreage, wood fiber demand will increase by some 23 percent, from 4.3 to 5.3 billion cubic feet annually, requiring rapid restocking, improved utilization, and accelerated harvest practices.

Table 25 - Land Treatment and Management Practices, 1970
Columbia-North Pacific Region

Types of Programs	Units	Subregions			Total
		1	2	3	
Area A					
Structural					
Streambank Stabilization	miles	347	244	17	608
Dikes & Levees	miles	24	4	46	74
Channel Improvement	miles	1,205	290	246	1,741
Erosion Control Structures	number	546	859	1,004	2,409
Ponds and Small Reservoirs	number	1,613	406	203	2,222
	ac-ft	38,800	96,600	5,100	140,500
Drainage	1,000 ac.	41	77	73	191
Nonstructural					
Erosion & Sediment Control	1,000 ac.	1,404	1,524	724	3,652
Water Conservation 1/	1,000 ac.	465	707	490	1,662
Protection & Management	1,000 ac.	18,934	6,968	2,722	28,624
Water Yield Improvement	1,000 ac.	-	-	-	-
Area B		4	5	6	
Structural					
Streambank Stabilization	miles	145	426	301	872
Dikes & Levees	miles	80	50	22	152
Channel Improvement	miles	183	540	687	1,410
Erosion Control Structures	number	3,517	2,956	159	6,632
Ponds and Small Reservoirs	number	3,900	4,900	6,200	15,000
	ac-ft	50,500	97,300	10,900	158,700
Drainage	1,000 ac.	72	46	44	162
Nonstructural					
Erosion & Sediment Control	1,000 ac.	2,805	3,022	1,906	7,733
Water Conservation 1/	1,000 ac.	2,410	1,421	269	4,100
Protection & Management	1,000 ac.	15,869	12,287	18,199	46,355
Water Yield Improvement	1,000 ac.	-	-	-	-

1/ Includes on-site water management practices on irrigated lands.

Table 25 - Continued

Types of Programs	Units	Subregions				Total
		7	9	10S	12	
Area C						
Structural						
Streambank Stabilization	miles	201	61	159	144	565
Dikes & Levees	miles	52	105	72	66	295
Channel Improvement	miles	583	344	680	88	1,695
Erosion Control Structures	number	10,689	73	305	857	11,924
Ponds and Small Reservoirs	number	4,215	1,033	181	2,111	7,540
	ac-ft	9,412	7,200	6,118	32,818	55,548
Drainage	1,000 ac.	17	135	25	40	217
Nonstructural						
Erosion & Sediment Control	1,000 ac.	1,927	863	48	681	3,519
Water Conservation1/	1,000 ac.	531	244	163	317	1,255
Protection & Management	1,000 ac.	10,823	5,275	10,190	6,141	32,429
Water Yield Improvement	1,000 ac.	-	-	-	-	-

Types of Programs	Units	8	10N	11	Total
Area D					
Structural					
Streambank Stabilization	miles	120	37	54	211
Dikes & Levees	miles	128	42	273	443
Channel Improvement	miles	81	244	119	444
Erosion Control Structures	number	21	137	9	167
Ponds and Small Reservoirs	number	12	69	1,247	1,328
	ac-ft	30,000	1,200	7,196	38,396
Drainage	1,000 ac.	48	5	282	335
Nonstructural					
Erosion & Sediment Control	1,000 ac.	67	19	292	378
Water Conservation1/	1,000 ac.	17	13	92	122
Protection & Management	1,000 ac.	2,694	3,693	6,460	12,847
Water Yield Improvement	1,000 ac.	-	-	-	-

Types of Programs	Units	Total
Region		
Structural		
Streambank Stabilization	miles	2,256
Dikes & Levees	miles	964
Channel Improvement	miles	5,290
Erosion Control Structures	number	21,132
Ponds and Small Reservoirs	number	26,090
	ac-ft	393,144
Drainage	1,000 ac.	905
Nonstructural		
Erosion & Sediment Control	1,000 ac.	15,282
Water Conservation1/	1,000 ac.	7,139
Protection & Management	1,000 ac.	120,255
Water Yield Improvement	1,000 ac.	-

1/ Includes on-site water management practices on irrigated lands.
Source: Appendix VIII, Land Measures & Watershed Protection.

Table 26 - Cumulative Gross Needs for Land Treatment and Management, Columbia-North Pacific Region

Types of Programs	Units	Thru 1970	Thru 1980	Thru 2000	Thru 2020
Area A					
Structural					
Streambank Stabilization	miles	608	2,147	3,966	5,296
Dikes & Levees	miles	74	228	376	493
Channel Improvement	miles	1,741	4,381	7,690	10,941
Erosion Control Structures	number	2,409	5,876	9,707	13,679
Ponds and Small Reservoirs	number	2,222	2,681	3,520	4,129
	ac-ft	140,500	215,400	291,600	328,700
Drainage	1,000 ac.	191	245	334	417
Nonstructural					
Erosion & Sediment Control	1,000 ac.	3,652	5,137	7,977	10,171
Water Conservation 1/	1,000 ac.	1,662	2,611	2,926	3,738
Protection & Management	1,000 ac.	28,624	29,275	29,974	30,605
Water Yield Improvement	1,000 ac.	0	52	147	244
Area B					
Structural					
Streambank Stabilization	miles	872	2,144	5,335	7,580
Dikes & Levees	miles	152	450	954	1,544
Channel Improvement	miles	1,410	3,359	6,691	9,639
Erosion Control Structures	number	6,632	28,832	57,632	80,932
Ponds and Small Reservoirs	number	15,000	28,600	44,370	62,600
	ac-ft	158,700	202,700	284,700	351,700
Drainage	1,000 ac.	162	285	397	536
Nonstructural					
Erosion & Sediment Control	1,000 ac.	7,733	12,164	18,467	24,558
Water Conservation 1/	1,000 ac.	4,100	5,175	5,539	6,254
Protection & Management	1,000 ac.	46,355	54,483	55,074	55,280
Water Yield Improvement	1,000 ac.	0	39	90	146

1/ Includes on-site water management practices on irrigated lands.

Table 26 - Continued

Types of Programs	Units	Thru 1970	Thru 1980	Thru 2000	Thru 2020
Area C					
Structural					
Streambank Stabilization	miles	565	1,811	3,309	4,766
Dikes & Levees	miles	295	772	1,424	2,078
Channel Improvement	miles	1,695	4,502	7,243	9,426
Erosion Control Structures	number	11,924	17,072	26,295	33,105
Ponds and Small Reservoirs	number	7,540	11,790	18,431	24,452
	ac-ft	55,548	92,115	141,222	174,629
Drainage	1,000 ac.	217	359	545	734
Nonstructural					
Erosion & Sediment Control	1,000 ac.	3,519	5,303	8,086	11,298
Water Conservation 1/	1,000 ac.	1,255	1,799	2,305	2,760
Protection & Management	1,000 ac.	32,429	33,669	34,296	34,394
Water Yield Improvement	1,000 ac.	0	20	52	109
Area D					
Structural					
Streambank Stabilization	miles	211	697	1,222	1,730
Dikes & Levees	miles	443	617	879	1,138
Channel Improvement	miles	444	1,481	2,721	3,809
Erosion Control Structures	number	167	455	1,489	3,234
Ponds and Small Reservoirs	number	1,328	1,988	2,998	4,323
	ac-ft	38,396	48,796	60,296	68,696
Drainage	1,000 ac.	335	396	488	565
Nonstructural					
Erosion & Sediment Control	1,000 ac.	378	583	952	1,324
Water Conservation 1/	1,000 ac.	122	242	309	390
Protection & Management	1,000 ac.	12,847	12,850	12,787	12,631
Water Yield Improvement	1,000 ac.	0	6	60	113
Region					
Structural					
Streambank Stabilization	miles	2,256	6,799	13,832	19,372
Dikes & Levees	miles	964	2,067	3,633	5,253
Channel Improvement	miles	5,290	13,723	24,345	33,815
Erosion Control Structures	number	21,132	52,235	95,123	130,950
Ponds and Small Reservoirs	number	26,090	45,059	69,319	95,504
	ac-ft	393,144	559,011	777,818	923,725
Drainage	1,000 ac.	905	1,285	1,764	2,252
Nonstructural					
Erosion & Sediment Control	1,000 ac.	15,282	23,187	35,482	47,351
Water Conservation 1/	1,000 ac.	7,139	9,827	11,079	13,142
Protection & Management	1,000 ac.	120,255	130,277	132,131	132,910
Water Yield Improvement	1,000 ac.	0	117	349	612

1/ Includes on-site water management practices on irrigated lands.
Source: Appendix VIII, Land Measures & Watershed Protection.

Rangeland is expected to decrease by about 4 percent or 2.3 million acres. These lands currently produce wildlife and provide forage for an estimated 9.3 percent of the regional beef and sheep production. The need for livestock production is projected to increase 153 percent by 2020. To meet part of this additional demand, future range forage production must be increased.

Future watershed needs include measures to resolve present watershed problems and to provide necessary protection required with projected changes in land and resource use. Table 26 shows the cumulative gross watershed needs at the end of each time period including present programs shown in table 25.

Lands produce nearly 40,000 acre-feet of sediment annually. Measures for erosion and sediment control will be needed to keep sediment yield down to acceptable limits on about 47.4 million acres by 2020, compared to some 15.3 million acres in 1970.

Flooding occurs on an estimated 3.9 million acres. About 1.6 million acres of cropland, 309,000 acres of rangeland, 225,000 acres of forest land, and 119,000 acres of urban and intensive use areas flood at one to five-year frequency. Flood damages on these lands would increase substantially if erosion and sediment control were not used in the upper watersheds.

There will be an increasing need for control of streamflows and channel and bank stabilization to protect adjacent lands, improve water quality, reduce flood damage, and satisfy fish passage and habitat requirements. Of the required bank stabilization, 38 percent is needed in forested areas, 36 percent in rangeland, and 26 percent in cropland. About 95 percent of the dikes and levees are required in cropland and urban areas with the remainder in range areas. Some 59 percent of the channel improvement is required in forest areas primarily for fish passage, 34 percent in cropland, and 7 percent in range areas.

The gross acreage requiring water conservation management practices associated with irrigation by 2020 amounts to 13.1 million acres. Additional development of ponds and reservoirs is necessary to conserve excessive runoff water for flood protection and subsequent use for irrigation, stock water, domestic use, recreation, and wildlife habitat. In addition there is need for specific water yield improvement programs in the upper watershed forest areas to increase ground-water storage and available surface water supplies.

Excessively wet areas needing drainage are indicated on an estimated 2.2 million acres of cropland. A 13 percent increase in problem areas on cropland was estimated resulting from an additional 6.0 million acres of new irrigated land.

Frequently a combination of improved practices, land treatment measures, and water control actions is necessary to meet more intensive multiple-use requirements of lands and resources. When a number of owners and managers are involved, a cooperative, coordinated effort is required. Of the 1,584 watersheds in the region, 908 have complex and interrelated watershed problems requiring such an approach for accelerated development. These are shown on table 27 by target date for development along with the types of problems involved and the extent of those problem areas.

IRRIGATION

General

In 1970 the 7.5 million irrigated acres comprised roughly a third of the region's cropland. Over 93 percent of this acreage was located in the semiarid area east of the Cascades. The Snake River Basin alone (Subregions 4 and 5) accounts for over 50 percent of the total. Although gravity irrigation methods are used on about three-fourths of the irrigated lands, sprinkler application has been increasing. About one-fourth of the irrigated land experiences late season water shortages.

Some 57 percent of the irrigated land is used for hay and pasture, 13 percent for small grains, 10 percent for potatoes and sugar beets, and 9 percent for vegetables, fruits, nuts, and berries; the remaining 11 percent is used for other crops and nonagricultural uses.

The total value generated from irrigation in 1964 was about $2.6 billion annually, of which about $740 million was from the sale of crops, livestock, and livestock products. The nonfarm economic activity associated with irrigated agriculture was estimated to total about $1.9 billion annually. In 1964, employment on irrigated farms was estimated at 77,000 or about half of the total farm employment.

Annual irrigation diversions as shown in table 28 total 33.7 million acre-feet, of which about 3.6 million acre-feet come from ground water. These withdrawals account for more than 95 percent of the water diverted for all consumptive uses and about three quarters of all ground-water withdrawals. Return flows total about 18.0 million acre-feet, resulting in a net depletion of 15.8 million acre-feet annually.

The estimated 2.0 million acres of the irrigated land with a seasonal water shortage include 200,000 acres using ground water and 1.8 million acres using surface water. About 45 percent of

Table 27 - Watershed Areas Needing Cooperative Development and Extent of Watershed Problems in Those Areas, Columbia-North Pacific Region

Target Date	Sub-region	Number of Watersheds	Flooding	Erosion	Drainage	Water Conservation New Lands	Water Conservation Supplemental	Land Treatment
			(1,000 acres with number of watersheds in parenthesis)					
1980								
	1		40.5	101.8	45.1	66.3	23.0	131.5
		(29)	(28)	(14)	(28)	(12)	(11)	(29)
	2		35.8	349.4	3.2	119.5	9.2	352.6
		(10)	(9)	(10)	(3)	(5)	(2)	(10)
	3		59.7	8.3	31.7	142.0	16.0	99.7
		(11)	(11)	(11)	(11)	(10)	(2)	(11)
	4		159.1	535.3	93.7	155.7	71.4	1,033.4
		(25)	(20)	(23)	(21)	(20)	(16)	(23)
	5		11.9	134.8	16.3	105.8	80.7	186.6
		(19)	(18)	(12)	(15)	(16)	(14)	(18)
	6		10.8	195.7	6.8	35.5	11.9	410.1
		(9)	(8)	(7)	(7)	(9)	(7)	(9)
	7		31.2	473.7	8.6	468.5	109.4	488.7
		(18)	(14)	(15)	(9)	(16)	(16)	(17)
	8		38.9	3.3	45.5	51.2	0.5	87.7
		(24)	(24)	(21)	(24)	(22)	(2)	(23)
	9		35.7	-	202.2	278.6	3.4	251.0
		(26)	(20)	-	(11)	(19)	(16)	(26)
	10N		58.6	48.9	52.3	70.7	-	107.5
		(17)	(17)	(8)	(16)	(17)	-	(17)
	10S		17.3	79.4	12.2	56.6	4.1	99.4
		(9)	(9)	(9)	(9)	(9)	(2)	(9)
	11		179.3	5.6	160.1	114.6	-	345.0
		(25)	(25)	(20)	(25)	(25)	-	(25)
	12		-	-	-	-	-	-
		-	-	-	-	-	-	-
Total			678.8	1,936.2	677.7	1,665.0	330.2	3,593.2
"		(222)	(203)	(150)	(179)	(180)	(88)	(217)
2000								
	1		63.9	135.6	89.0	202.8	37.0	166.5
		(46)	(43)	(13)	(38)	(17)	(17)	(46)
	2		22.4	232.0	11.9	276.2	5.7	243.8
		(28)	(25)	(21)	(8)	(25)	(8)	(28)
	3		7.5	2.2	7.3	78.6	5.5	17.0
		(6)	(6)	(6)	(6)	(6)	(2)	(6)
	4		109.4	605.2	150.7	182.9	169.7	1,055.1
		(33)	(28)	(29)	(25)	(27)	(22)	(31)
	5		43.5	818.5	144.2	212.6	86.4	642.6
		(29)	(26)	(24)	(24)	(29)	(17)	(29)
	6		98.5	952.6	97.5	277.4	73.8	1,987.1
		(36)	(28)	(33)	(30)	(32)	(20)	(36)
	7		12.9	305.1	10.2	679.2	112.9	318.3
		(20)	(16)	(18)	(11)	(20)	(20)	(19)
	8		34.2	6.1	40.2	45.0	0.9	80.8
		(13)	(13)	(13)	(13)	(13)	(1)	(13)
	9		26.6	0.7	86.7	142.2	2.9	87.4
		(23)	(23)	(8)	(23)	(23)	(20)	(23)
	10N		55.7	91.1	78.5	42.2	-	169.6
		(20)	(20)	(11)	(19)	(16)	-	(20)
	10S		14.1	72.9	24.0	38.8	16.7	100.9
		(11)	(11)	(11)	(11)	(10)	(4)	(11)
	11		67.8	7.9	63.5	117.3	-	139.2
		(59)	(35)	(22)	(49)	(35)	-	(49)
	12		128.4	327.9	121.9	133.5	203.8	465.3
		(12)	(12)	(12)	(12)	(12)	(12)	(12)
Total			684.9	3,557.8	925.6	2,428.7	715.3	5,473.6
"		(336)	(296)	(221)	(269)	(265)	(143)	(323)

Table 27 - Continued

Target Date	Sub-region	Number of Watersheds	Flooding	Erosion	Drainage	Water Conservation New Lands	Water Conservation Supplemental	Land Treatment
			(1,000 acres with number of watersheds in parenthesis)					
2020								
	1		70.7	72.4	95.5	112.8	45.3	109.6
		(50)	(36)	(10)	(39)	(14)	(13)	(48)
	2		54.3	888.0	34.6	1,309.9	22.4	922.6
		(65)	(36)	(44)	(19)	(51)	(19)	(52)
	3		6.0	0.4	0.9	54.0	-	7.3
		(7)	(1)	(1)	(2)	(4)	-	(2)
	4		97.1	750.2	65.4	444.6	137.1	1,092.5
		(41)	(24)	(36)	(19)	(33)	(23)	(38)
	5		12.4	925.2	36.2	541.2	79.5	546.4
		(47)	(29)	(36)	(32)	(43)	(28)	(43)
	6		9.8	176.5	12.1	125.3	5.7	330.2
		(17)	(12)	(14)	(10)	(15)	(8)	(17)
	7		8.1	478.6	2.0	211.0	126.2	486.7
		(29)	(15)	(21)	(7)	(29)	(29)	(22)
	8		2.1	0.3	2.0	7.8	-	4.1
		(7)	(1)	(3)	(5)	(5)	-	(5)
	9		35.5	1.9	128.6	229.2	4.0	130.5
		(23)	(23)	(10)	(23)	(23)	(12)	(23)
	10N		10.7	54.1	9.4	5.6	-	64.8
		(25)	(15)	(7)	(16)	(11)	-	(19)
	10S		8.2	16.1	5.0	29.4	2.6	26.9
		(9)	(9)	(9)	(9)	(9)	(3)	(9)
	11		298.2	20.6	11.7	18.8	-	35.5
		(26)	(18)	(14)	(21)	(15)	-	(21)
	12		4.5	8.5	4.2	17.3	32.3	13.3
		(4)	(4)	(4)	(4)	(4)	(4)	(4)
Total			617.6	3,392.8	407.6	3,106.9	455.1	3,770.4
"		(350)	(223)	(209)	(206)	(256)	(139)	(303)
Grand Total 1970-2020			1,981.3	8,886.8	2,010.9	7,200.6	1,500.6	12,837.2
		(908)	(712)	(580)	(654)	(701)	(370)	(843)

Source: Appendix VIII, Land Measures & Watershed Protection.

Table 28 - Irrigation Water Use by Area and Subregion, 1970
Columbia-North Pacific Region

Area and Subregion	Source	Acres	Average Annual Diversions	Average Annual Return Flows (acre-feet)	Average Annual Depletions
Area A					
Subregion 1	Surface	485,000	1,989,000	1,249,000	740,000
	Ground	45,000	137,000	64,000	73,000
	Total	530,000	2,126,000	1,313,000	813,000
Subregion 2	Surface	696,000	3,182,000	536,000	2,646,000
	Ground	108,000	410,000	172,000	238,000
	Total	804,000	3,592,000	708,000	2,884,000
Subregion 3	Surface	488,000	2,405,000	1,293,000	1,112,000
	Ground	21,000	80,000	42,000	38,000
	Total	509,000	2,485,000	1,335,000	1,150,000
Totals	Surface	1,669,000	7,576,000	3,078,000	4,498,000
	Ground	174,000	627,000	278,000	349,000
		1,843,000	8,203,000	3,356,000	4,847,000
Area B					
Subregion 4	Surface	1,811,000	11,445,000	7,734,000	3,711,000
	Ground	674,000	2,096,000	887,000	1,209,000
	Total	2,485,000	13,541,000	8,621,000	4,920,000
Subregion 5	Surface	1,397,000	6,159,000	3,307,000	2,852,000
	Ground	68,000	211,000	88,000	123,000
	Total	1,465,000	6,370,000	3,395,000	2,975,000
Subregion 6	Surface	265,000	1,050,000	534,000	516,000
	Ground	11,000	35,000	18,000	17,000
	Total	276,000	1,085,000	552,000	533,000
Totals	Surface	3,473,000	18,654,000	11,575,000	7,079,000
	Ground	753,000	2,342,000	993,000	1,349,000
		4,226,000	20,996,000	12,568,000	8,428,000

Table 28 - Continued

Area and Subregion	Source	Acres	Diversions	Return Flows	Depletions
			Average Annual (acre-feet)		
Area C					
Subregion 7	Surface	498,000	2,143,000	1,107,000	1,036,000
	Ground	55,000	191,000	87,000	104,000
	Total	553,000	2,334,000	1,194,000	1,140,000
Subregion 9	Surface	142,500	330,000	115,000	215,000
	Ground	101,500	239,000	82,000	157,000
	Total	244,000	569,000	197,000	372,000
Subregion 10S	Surface	167,000	572,700	251,400	321,300
	Ground	1,000	2,400	900	1,500
	Total	168,000	575,100	252,300	322,800
Subregion 12	Surface	312,400	705,000	309,000	396,000
	Ground	14,600	44,000	18,000	26,000
	Total	327,000	749,000	327,000	422,000
Totals	Surface	1,119,900	3,750,700	1,782,400	1,968,300
	Ground	172,100	476,400	187,900	288,500
		1,292,000	4,227,100	1,970,300	2,256,800
Area D					
Subregion 8	Surface	16,500	30,000	11,000	19,000
	Ground	5,500	9,000	2,000	7,000
	Total	22,000	39,000	13,000	26,000
Subregion 10N	Surface	9,200	19,100	6,400	12,700
	Ground	6,800	9,900	2,600	7,300
	Total	16,000	29,000	9,000	20,000
Subregion 11	Surface	58,000	148,000	24,000	124,000
	Ground	46,000	97,000	25,000	72,000
	Total	104,000	245,000	49,000	196,000
Totals	Surface	83,700	197,100	41,400	155,700
	Ground	58,300	115,900	29,600	86,300
		142,000	313,000	71,000	242,000
Region	Surface	6,345,600	30,177,800	16,476,800	13,701,000
	Ground	1,157,400	3,561,300	1,488,500	2,072,800
	Total	7,503,000	33,739,100	17,965,300	15,773,800

Source: Appendix IX, Irrigation, and comprehensive water and related land resource studies of Willamette River Basin (Subregion 9) and Puget Sound & Adjacent Waters (Subregion 11), adjusted to 1970.

this shortage occurs in the Snake River Basin (Subregions 4 and 5), 14 percent in the Oregon Closed Basin, and 13 percent in the Mid Columbia. Significant shortages also occur in Subregions 1, 3, and 6.

There are some 33 million acres of dryland in the region suitable for irrigation, much of it under native grass and sage cover in eastern Oregon and southern Idaho. Virtually all of the region's 13.7 million acres of dry cropland and a small amount of forest land are also included.

As shown in table 8, nearly half of the potentially irrigable land was given a class 1 or 2 rating. Under irrigation, these lands would be capable of producing good yields of virtually all climatically adapted crops. Class 3 and "other" lands are of only fair to marginal quality for irrigation development, being limited in crop diversity and productivity.

Needs

Based on the region's share of the projected national demand for food and fiber and taking into account expected yield improvement from both dry and irrigated lands, an estimated 6.0 million acres of new irrigation will be required by 2020. This level of development was based on the assumption that the inadequately irrigated land (2.0 million acres) would be provided a full supply. The new irrigation requirement was apportioned among the subregions by considering the availability of potentially irrigable lands and water supplies, historic trends and present levels of irrigation development and production, and competitive demands for use of land and water resources. Land and water needs for supplemental irrigation are shown in table 29. Table 30 gives projected new irrigation land and water needs for both new and supplemental irrigation.

To irrigate the new lands needed by 2020 and provide supplemental supplies to water-short lands, annual diversions would need to be increased from 33.7 million acre-feet in 1970 to 57.3 million acre-feet by 2020. This includes more than 2.2 million acre-feet of supplemental water for the water-short areas.

By 2020, total depletions for irrigation are expected to be about 29.2 million acre-feet annually, an increase of 13.4 million acre-feet over the 1970 level.

Details on projected land and water needs for irrigation are presented in Appendix IX, Irrigation.

Table 29 - Projected Supplemental Irrigation Needs, by Area and Subregion
Columbia-North Pacific Region

Area and Subregion	Item	Units	Incremental Needs 1970-1980	1981-2000	2001-2020	1970-2020
Area A						
Subregion 1	Area	1,000 ac.	195	0	0	195
	Diversions	1,000 ac-ft	106	0	0	106
	Depletions	1,000 ac-ft	50	0	0	50
Subregion 2	Area	1,000 ac.	37	0	0	37
	Diversions	1,000 ac-ft	63	0	0	63
	Depletions	1,000 ac-ft	30	0	0	30
Subregion 3	Area	1,000 ac.	106	0	0	106
	Diversions	1,000 ac-ft	60	0	0	60
	Depletions	1,000 ac-ft	40	0	0	40
Totals	Area	1,000 ac.	338	0	0	338
	Diversions	1,000 ac-ft	229	0	0	229
	Depletions	1,000 ac-ft	120	0	0	120
Area B						
Subregion 4	Area	1,000 ac.	510	0	0	510
	Diversions	1,000 ac-ft	704	0	0	704
	Depletions	1,000 ac-ft	310	0	0	310
Subregion 5	Area	1,000 ac.	393	0	0	393
	Diversions	1,000 ac-ft	504	0	0	504
	Depletions	1,000 ac-ft	265	0	0	265
Subregion 6	Area	1,000 ac.	127	0	0	127
	Diversions	1,000 ac-ft	130	0	0	130
	Depletions	1,000 ac-ft	67	0	0	67
Totals	Area	1,000 ac.	1,030	0	0	1,030
	Diversions	1,000 ac-ft	1,338	0	0	1,338
	Depletions	1,000 ac-ft	642	0	0	642

Table 29 - Continued

Area and Subregion	Item	Units	Incremental Needs 1970-1980	1981-2000	2001-2020	1970-2020
Area C						
Subregion 7	Area	1,000 ac.	251	0	0	251
	Diversions	1,000 ac-ft	297	0	0	297
	Depletions	1,000 ac-ft	158	0	0	158
Subregion 9	Area	1,000 ac.	26	0	0	26
	Diversions	1,000 ac-ft	15	0	0	15
	Depletions	1,000 ac-ft	8	0	0	8
10S	Area	1,000 ac.	47	0	0	47
	Diversions	1,000 ac-ft	38	0	0	38
	Depletions	1,000 ac-ft	21	0	0	21
12	Area	1,000 ac.	278	0	0	278
	Diversions	1,000 ac-ft	330	0	0	330
	Depletions	1,000 ac-ft	188	0	0	188
Totals	Area	1,000 ac.	602	0	0	602
	Diversions	1,000 ac-ft	680	0	0	680
	Depletions	1,000 ac-ft	375	0	0	375
Area D						
Subregion 8	Area	1,000 ac.	0	0	0	0
	Diversions	1,000 ac-ft	0	0	0	0
	Depletions	1,000 ac-ft	0	0	0	0
Subregion 10N	Area	1,000 ac.	0	0	0	0
	Diversions	1,000 ac-ft	0	0	0	0
	Depletions	1,000 ac-ft	0	0	0	0
Subregion 11	Area	1,000 ac.	0	0	0	0
	Diversions	1,000 ac-ft	0	0	0	0
	Depletions	1,000 ac-ft	0	0	0	0
Totals	Area	1,000 ac.	0	0	0	0
	Diversions	1,000 ac-ft	0	0	0	0
	Depletions	1,000 ac-ft	0	0	0	0
Region						
	Area	1,000 ac.	1,970	0	0	1,970
	Diversions	1,000 ac-ft	2,247	0	0	2,247
	Depletions	1,000 ac-ft	1,137	0	0	1,137

Source: Appendix IX, Irrigation.

Table 30 - Present and Projected Irrigation Land and Water Needs, by Area and Subregion, Columbia-North Pacific Region1/ 2/

Area and Subregion	Item	Unit	Present 1970	Incremental Needs 1970-1980	1981-2000	2001-2020	1970 2020
Area A							
Subregion 1	Area	1,000 ac.	530	330	90	370	790
	Diversions	1,000 ac-ft	2,126	1,039	308	1,128	2,475
	Depletions	1,000 ac-ft	813	582	150	745	1,477
Subregion 2	Area	1,000 ac.	804	476	210	430	1,116
	Diversions	1,000 ac-ft	3,592	2,386	1,019	1,587	4,992
	Depletions	1,000 ac-ft	2,884	1.078	217	770	2,065
Subregion 3	Area	1,000 ac.	509	41	20	40	101
	Diversions	1,000 ac-ft	2,485	264	96	152	512
	Depletions	1,000 ac-ft	1,150	144	49	102	295
Totals	Area	1,000 ac.	1,843	847	320	840	2,007
	Diversions	1,000 ac-ft	8,203	3,689	1,423	2,867	7,979
	Depletions	1,000 ac-ft	4,847	1,804	416	1,617	3,837
Area B							
Subregion 4	Area	1,000 ac.	2,485	435	110	180	725
	Diversions	1,000 ac-ft	13,451	2,362	340	552	3,254
	Depletions	1,000 ac-ft	4,920	1,244	230	374	1,848
Subregion 5	Area	1,000 ac.	1,465	485	170	340	995
	Diversions	1,000 ac-ft	6,370	2,281	649	1,436	4,366
	Depletions	1,000 ac-ft	2,975	1,460	415	942	2,817
Subregion 6	Area	1,000 ac.	276	164	110	220	494
	Diversions	1,000 ac-ft	1,085	634	432	826	1,892
	Depletions	1,000 ac-ft	533	437	250	480	1,167
Totals	Area	1,000 ac.	4,226	1,084	390	740	2,214
	Diversions	1,000 ac-ft	20,996	5,277	1,421	2,814	9,512
	Depletions	1,000 ac-ft	8,428	3,141	895	1,796	5,832

1/ Acreage in Appendix IX, Irrigation, reduced by 161,000 acres in first time period to include estimated increase in irrigation between 1966 and 1970. Also a reduction of 2,000 acres in second time period and an increase of 7,000 acres in third were made to reflect data from comprehensive study of Puget Sound & Adjacent Waters. These adjustments are reflected in diversions and depletions.

2/ This table includes projected supplemental water needs shown in table 29.

Table 30 - Continued

Area and Subregion	Item	Unit	Present 1970	Incremental Needs 1970-1980	1981-2000	2001-2020	1970 2020
Area C							
Subregion 7	Area	1,000 ac.	553	307	90	270	667
	Diversions	1,000 ac-ft	2,334	1,721	260	972	2,953
	Depletions	1,000 ac-ft	1,140	890	220	700	1,810
Subregion 9	Area	1,000 ac.	244	186	420	150	756
	Diversions	1,000 ac-ft	569	589	1,034	268	1,891
	Depletions	1,000 ac-ft	372	325	657	213	1,195
Subregion 10S	Area	1,000 ac.	168	57	4	24	85
	Diversions	1,000 ac-ft	575	244	8	72	324
	Depletions	1,000 ac-ft	323	106	3	45	154
Subregion 12	Area	1,000 ac.	327	3	10	0	13
	Diversions	1,000 ac-ft	749	340	32	0	372
	Depletions	1,000 ac-ft	422	198	10	0	208
Totals	Area	1,000 ac.	1,292	553	524	444	1,521
	Diversions	1,000 ac-ft	4,227	2,894	1,334	1,312	5,540
	Depletions	1,000 ac-ft	2,257	1,519	890	958	3,367
Area D							
Subregion 8	Area	1,000 ac.	22	38	10	30	78
	Diversions	1,000 ac-ft	39	94	22	81	197
	Depletions	1,000 ac-ft	26	63	15	54	132
Subregion 10N	Area	1,000 ac.	16	39	6	16	61
	Diversions	1,000 ac-ft	29	74	10	38	122
	Depletions	1,000 ac-ft	20	51	7	25	83
Subregion 11	Area	1,000 ac.	104	34	48	37	119
	Diversions	1,000 ac-ft	245	47	95	77	219
	Depletions	1,000 ac-ft	196	33	70	66	169
Totals	Area	1,000 ac.	142	111	64	83	258
	Diversions	1,000 ac-ft	313	215	127	196	538
	Depletions	1,000 ac-ft	242	147	92	145	384
Region							
	Area 1/	1,000 ac.	7,503	2,595	1,298	2,107	6,000
	Diversions	1,000 ac-ft	33,739	12,075	4,305	7,189	23,569
	Depletions	1,000 ac-ft	15,774	6,611	2,293	4,516	13,420

1/ See footnote 1, page 103.

Source: Appendix IX, Irrigation, and comprehensive water and related land resource studies of Willamette River Basin and Puget Sound & Adjacent Waters, adjusted to 1970.

NAVIGATION

General

Waterborne commerce has roots deep in Pacific Northwest history, as much of the exploration, settlement, and development of the region was accomplished by the use of water transportation. The Pacific Ocean provided access to the coastal bays and rivers in the early days and has been used since in the establishment of significant coastwise and foreign trades. Transportation on the Columbia and other rivers was vital to the opening and settlement of the interior and has been important in building internal and supplementing external commerce.

Foreign and coastwise trade have been essential in the region's growth, permitting export of its surplus agricultural and forest production and import of consumer goods and raw materials required for manufacturing.

There are 16 principal deep-draft ports in the Columbia-North Pacific Region capable of handling ocean-going vessels. Puget Sound and the Columbia River are the two most important bodies of water in the region's ocean trade, serving respectively its two largest metropolitan areas, Seattle and Portland, and other important centers of industry and trade. Puget Sound and the adjacent inland waters, with direct access to the Pacific Ocean through the Strait of Juan de Fuca, are essentially a huge natural harbor, with sufficient depths to accommodate the world's largest cargo carriers. The controlling depth is about 200 feet in the Strait and at the entrance to Puget Sound and 50 feet or more at the entrance to all major harbors except 40 feet at Olympia. Entrances to most harbors within the Sound permit unrestricted access and are protected from ocean waves and storms Depths at berths and docks vary from 25 to 70 feet. There are seven major deep-draft ports on the Sound: Bellingham, Anacortes, Everett, Seattle, Tacoma, Olympia, and Port Angeles. In the Puget Sound area approximately 100 minor harbors and waterways are used primarily for rafting of logs, barge shipments of sand and gravel, ferry traffic, and for fishing and recreational boats.

Deep-draft ports on the Oregon and Washington coast have been developed primarily to serve the forest products industry. Principal among the lumber shipping ports is Coos Bay. Other lumber shipping points are Yaquina Bay, Grays Harbor, and Willapa Bay. Several shallow draft harbors along the coast have been improved for use by commercial fishing and recreational boats and for barge movement of lumber in the coastwise trade.

The Columbia River, like the Mississippi and St. Lawrence, is one of the Nation's great inland waterways. It, together with the Willamette River to Portland, provides the principal waterborne outlet for a large part of Oregon, Washington, and Idaho. Its entrance channel, approved to a depth of 48 feet, and 40-foot interior channels entend deep-draft navigation service 106 miles upstream to Vancouver, Washington, and 12 miles on the lower Willamette River to the principal port of Portland. Other major ports on the Columbia River include Vancouver, Longview, Kalama, and Astoria. Side channels along the deep-draft channel in the lower Columbia River provide harbors for tugs and barges, fishing boats, recreational craft, and log raft storage.

The most important inland waterway in the region is the Columbia-Snake barge channel which, upon completion in 1975, will extend from the head of deep water navigation at Vancouver to the Pasco-Kennewick area on the Columbia and to Lewiston on the Snake River, 465 miles from the sea. This important waterway connects the agricultural hinterland with the deep-draft ports on the lower Columbia River.

The Willamette River above Portland has an improved open river channel to Oregon City, Albany, and Corvallis, and a series of four locks at Willamette Falls. The channel is used primarily for towing log rafts and, in its lower reaches, for barge movement of sand and gravel, lime rock and paper products.

An open river channel in the Snake River extends 90 miles above Lewiston. Commerce is not large but the channel is significant in that it provides the route for a regular mail boat run carrying supplies to otherwise isolated areas along the river. Other rivers in the region are not used for navigation except for recreational and excursion boats and for local movements of log rafts and sand and gravel in their tidal reaches.

A growing recreational boat traffic is taking advantage of the through inland waterway as it has been extended upstream. In addition, the individual reservoirs are used extensively for recreational boating. Marinas have been established or are being planned on most reservoirs. Small boat basins have been built in many locations along the Columbia River.

Adequate port facilities are available throughout the region to meet the requirements of vessel traffic and commerce at each port. The major ports, such as Seattle and Portland, have extensive terminal facilities. Terminal facilities along the Columbia-Snake inland waterway include grain elevators, petroleum storage tanks, and facilities for storage of bulk cement and fertilizer.

Excellent dry dock facilities are available on Puget Sound and at Portland for repair of marine vessels in commercial service, and the Navy maintains a repair yard at Bremerton. Similar facilities are available for small boats at most port cities in the region. Adequate bunkering facilities are available throughout the region.

Small boat moorage spaces and launching facilities are available on the navigable waterways throughout the region. Fifty-seven percent of the moorage facilities and 37 percent of the launching facilities are located in the Puget Sound area. In the eastern part of the region, boat launching ramps are usually associated with picnicking and camping facilities.

In 1968 nearly 106 million tons of commerce were moved over waterways in the region. This total comprised 28.4 million tons of foreign imports and exports (27 percent), 16.4 million tons of coastwise shipments and receipts (15 percent), and 61.0 million tons of internal and local movements (58 percent). Although the region has only 3 percent of the Nation's population and produces only 3 percent of the total output, about 6 percent of the Nation's oceanborne commerce moves over the region's waterways. The region handled about 3 percent of the Nation's total imports, 10 percent of total foreign exports, and accounted for 7 percent of total coastwise commerce. The two principal ports of the region, Seattle and Portland, ranked 9th and 10th nationally, handled 40 percent of the region's oceanborne commerce.

Needs

As waterborne commerce is related to the economic development of the region, it can be expected that future shipping needs will be governed in many respects by economic production patterns already established in the region. Agricultural and forest products production will continue to be important facets of the region's economy, with continuation of shipping requirements for exporting surpluses to national and world markets. The manufacturing base of the region will expand and diversify with increasing requirements for importation of raw materials and export of finished products. As population expands, petroleum products and other consumer goods must be imported. The national and regional projections of population, employment, income, and production provide the broad economic parameters for projecting future trends in production and consumption of many commodities pertinent to waterborne commerce. These have been supplemented as necessary by projections from other sources and by more detailed analyses of future traffic movements wherever available from other studies.

Estimates of prospective waterborne commerce considered total commodity production and consumption in each subregion's sphere of influence, the historical trends in waterborne commerce, locational factors of population and industry which would affect the division of traffic among transportation modes, and the location of markets and sources of raw materials for industrial requirements within the tributary area. A summary of the region's projected waterborne commerce for 1980, 2000, and 2020 is shown in table 31. The table illustrates the importance of the region's two great waterways. Subregions 7 and 8 consist essentially of the middle and lower Columbia River and Subregion 11 the Puget Sound.

Table 31 - Projected Waterborne Commerce
Columbia-North Pacific Region

Sub-region	1968 Internal	1968 Foreign & Coastwise	1980 Internal	1980 Foreign & Coastwise	2000 Internal	2000 Foreign & Coastwise	2020 Internal	2020 Foreign & Coastwise
	(1,000 short tons)							
2	170		4,300		6,000		7,800	
6	470		1,800		3,600		6,700	
7	1,410		8,700		12,100		15,300	
8	11,500	16,800	11,600	29,400	14,800	43,600	20,100	57,500
9	5,330		6,400		7,700		14,100	
10	8,200	6,200	8,200	7,300	8,200	7,600	8,200	8,600
11	25,200	22,300	31,800	35,000	57,800	67,700	118,400	133,600
Total	52,280	45,300	72,800	71,700	110,200	118,900	190,600	199,700

Source: Appendix X, Navigation.

Significant growth in foreign and domestic coastwise and domestic internal commerce is projected over the 50-year study period. Additional lands will be required for terminal facilities to service these projected tonnages, as well as to meet the needs of water transport-oriented industry.

Harbor and channel deepening projects would be required to insure that the world fleet, with a growing trend to deeper drafts, can be served in the waterways and berths of the area. Channel depths of over 100 feet would be needed in some locations.

Increased efficiency in cargo handling and land use would be necessary in order for the area ports to remain competitive. Greater cooperation among ports and centralized planning are indicated as means of achieving these efficiencies. Many inland areas currently are not served by waterborne transportation. Studies are needed to determine the feasibility of extending navigation to some of these areas.

Planning of the land transportation network, including warehousing, consolidation, and distribution facilities for

integration with waterborne transportation is needed to take advantage of such innovations as containerization and unit transport. Evaluation of shoreland resources suitable for port terminal facilities and water-dependent industrial use is needed. Alternative land uses need to be weighed. Environmental, social, and esthetic considerations should be incorporated into navigation developments to avoid degradation of the valued marine environment. The requirement exists for the proper disposal of dredged materials in order to minimize or eliminate possible adverse effects on the environment. Public demand for recreation boating facilities has reached significant proportions in the area. Accelerated development of small boat facilities would be required to meet this need and permit full utilization of the recreation boating advantages.

MUNICIPAL AND INDUSTRIAL WATER SUPPLY

General

Overall, the region has more than enough water to meet domestic and industrial requirements well into the next century. However, the capacity of some existing sources to satisfy future needs is questionable (table 95).

Municipal water supply problems exist in localized areas of the Columbia Plateau, Snake River Plain, and the Oregon Closed Basin, as well as seasonal shortages in some coastal areas of Oregon. Common problems with ground-water sources are excessive depths to the water table and aquifers of low yield. Many areas utilizing surface-water sources experience short-term deficiencies due to seasonal streamflow variation. Although naturally occurring high quality water has been the major requirement in water supply selection in the past, it may be a luxury that will have to be foregone in the future. Municipal water sources, whether ground or surface water, will require adequate treatment to assure the desired water quality.

Industrial water supply problems are limited and localized in nature. In general, volume, rather than water quality, has been the limiting factor. Shortages have curtailed industrial development in certain areas of the Columbia Plateau and the Snake River Plain and in some places with low seasonal streamflows. Water quality problems have necessitated special treatment in many areas. Surface waters may require disinfection or sediment and mineral removal depending on the use.

Rural-domestic water supply problems are widespread although related principally to quality rather than volume.

The supply must be of such a quality that it can be used in the raw state or made acceptable with minimum treatment. Shallow wells may become contaminated, yet deep wells may be too costly for an individual to develop. Most surface waters have turbidities which limit their use by individuals.

Municipalities currently obtain 56 percent of their water from surface sources, 32 percent from ground water, and 12 percent from a combination of both. Included in this are the industries on municipal supply systems. No estimate has been made of the ground-surface water distribution of industrial or rural-domestic supplies except that less than 25 percent of the rural-domestic population is served by community-type systems. Based on this, about 75 percent of the rural-domestic supply is probably from ground water. Use in 1970 is shown on table 32.

From the standpoint of municipal and industrial requirements, there are few serious water quality problems in the region. There are scattered reaches of the Clark Fork, Snake, and Silvies that display high coliform counts, generally during low summer flows but this water responds to treatment and is still usable. Turbidity, associated with high winter flows, is a problem in areas of the Puget Sound, Coastal, and Mid Columbia Subregions.

The Snake River probably has the most serious problem from a water quality standpoint principally from food processing and land use activities. From eastern Idaho to its confluence with the Salmon, there are several reaches with poor water quality, usually during periods of low flow. Heavy algae growth and high coliform counts limit its use for some purposes.

Needs

Projections indicate that by 2020 the region's municipal water supply requirements will increase by over 254 percent, industrial requirements by 146 percent, and rural-domestic requirements by 72 percent. The relatively low increase projected for rural-domestic supplies is due to anticipated reductions in future rural populations plus the incorporation of more rural areas into urban distribution systems. These projections are summarized in table 32.

Food processing, the pulp and paper industry, metallurgy, and chemical manufacturing will continue to be the major industrial water users. In general, growth will continue at existing sites before expansion to other points in the region. When this does occur, the pulp and paper industry will require new supplies at Plains or Libby in Subregion 1, the Bliss area in Subregion 4, the Weiser area in Subregion 5, and along the Columbia River in

Table 32 - Present & Projected Municipal, Industrial, and Rural-Domestic Wa
Columbia-North Pacific Region

Area and Subregion		Municipal 1970	Municipal 1980	Municipal 2000	Municipal 2020	Industrial 1970	Industrial 1980	Industrial 2000	Industrial 2020	Rural-Domestic 1970	Rural-Domestic 1980	Rural-Domestic 2000
		(mgd)										
Area A	1	131.1	159.9	228.3	319.0	153.3	181.0	214.4	247.5	24.9	28.9	35.8
	2	49.0	62.2	98.6	145.2	56.8	78.4	107.7	144.5	18.7	21.9	29.0
	3	28.7	38.7	59.1	81.9	26.4	32.2	44.1	58.6	17.9	21.2	24.4
Total		208.8	260.8	386.0	546.1	236.5	291.6	366.2	450.6	61.5	72.0	89.2
Area B	4	53.9	70.6	109.1	156.4	85.7	112.7	172.5	248.6	30.4	35.6	44.0
	5	48.7	63.5	100.4	145.7	34.2	54.0	88.9	129.3	29.0	35.0	43.4
	6	31.7	39.0	55.4	72.0	59.1	67.4	77.1	85.4	13.8	16.2	20.6
Total		134.3	173.1	264.9	374.1	179.0	234.1	338.5	463.3	73.2	86.8	108.0
Area C	7	42.9	51.0	75.1	96.6	74.8	96.7	113.6	139.2	18.3	22.4	29.3
	8	233.5	361.1	562.8	920.1	199.2	230.6	332.2	483.8	18.5	23.1	29.7
	10S	37.5	48.0	74.9	109.2	156.7	225.1	288.9	315.7	12.6	15.1	18.0
	12	1.8	2.5	3.7	5.1	1.5	1.6	1.6	1.7	3.9	4.4	5.6
Total		315.7	462.6	716.5	1,130.0	432.2	554.0	736.3	940.4	53.3	65.0	82.6
Area D	8	33.3	47.1	70.4	100.4	409.1	518.4	739.2	849.5	8.7	8.8	10.7
	10N	13.7	17.2	23.8	31.3	110.9	135.6	174.9	188.8	3.3	3.8	5.0
	11	302.7	472.0	736.3	1,231.5	543.3	765.9	1,285.5	1,930.6	9.8	12.6	18.6
Total		349.7	536.3	830.5	1,363.2	1,063.3	1,419.9	2,199.6	2,968.9	21.8	25.2	34.3
Region		1,008.5	1,432.8	2,197.9	3,414.4	1,911.0	2,499.6	3,640.6	4,823.2	209.8	249.0	314.1

Source: Appendix XI, Municipal and Industrial Water Supply, and comprehensive water and related land resource stud
Puget Sound & Adjacent Water (Subregion 11), adjusted to 1970.

32 - Present & Projected Municipal, Industrial, and Rural-Domestic Water Use
Columbia-North Pacific Region

	Industrial				Rural-Domestic				Total			
020	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020
			(mgd)									
19.0	153.3	181.0	214.4	247.5	24.9	28.9	35.8	44.6	309.3	369.8	478.5	611.1
45.2	56.8	78.4	107.7	144.5	18.7	21.9	29.0	38.0	124.5	162.5	235.3	327.7
81.9	26.4	32.2	44.1	58.6	17.9	21.2	24.4	27.0	73.0	92.1	127.6	167.5
46.1	236.5	291.6	366.2	450.6	61.5	72.0	89.2	109.6	506.8	624.4	841.4	1,106.3
56.4	85.7	112.7	172.5	248.6	30.4	35.6	44.0	53.4	170.0	218.9	325.6	458.4
45.7	34.2	54.0	88.9	129.3	29.0	35.0	43.4	53.0	111.9	152.5	232.7	328.0
72.0	59.1	67.4	77.1	85.4	13.8	16.2	20.6	25.0	104.6	122.6	153.1	182.4
74.1	179.0	234.1	338.5	463.3	73.2	86.8	108.0	131.4	386.5	494.0	711.4	968.8
96.6	74.8	96.7	113.6	139.2	18.3	22.4	29.3	37.4	136.0	170.1	218.0	273.2
20.1	199.2	230.6	332.2	483.8	18.5	23.1	29.7	36.9	451.2	614.8	924.7	1,440.8
09.2	156.7	225.1	288.9	315.7	12.6	15.1	18.0	19.9	206.8	288.2	381.8	444.8
5.1	1.5	1.6	1.6	1.7	3.9	4.4	5.6	6.9	7.2	8.5	10.9	13.7
30.0	432.2	554.0	736.3	940.4	53.3	65.0	82.6	101.1	801.2	1,081.6	1,535.4	2,172.5
00.4	409.1	518.4	739.2	849.5	8.7	8.8	10.7	12.2	451.1	574.3	820.3	962.1
31.3	110.9	135.6	174.9	188.8	3.3	3.8	5.0	6.2	127.9	156.6	203.7	226.3
31.5	543.3	765.9	1,285.5	1,930.6	9.8	12.6	18.6	26.6	855.8	1,250.5	2,040.4	3,188.7
63.2	1,063.3	1,419.9	2,199.6	2,968.9	21.8	25.2	34.3	45.0	1,434.8	1,981.4	3,064.4	4,377.1
14.4	1,911.0	2,499.6	3,640.6	4,823.2	209.8	249.0	314.1	387.1	3,129.3	4,181.4	6,152.6	8,624.7

Water Supply, and comprehensive water and related land resource studies of Willamette River Basin (Subregion 9) and
n 11), adjusted to 1970.

2

Subregion 7. Primary metals may locate a new processing plant along the Blackfoot or Bull Rivers in Subregion 1, and food processing may require a new development in Subregion 12. Other than this, the balance of the industrial growth probably will be in the existing service areas.

WATER QUALITY AND POLLUTION CONTROL

General

In contrast to conditions in many other parts of the Nation, water quality in the region is still generally very good, with vast quantities of relatively unpolluted water available. However, serious problems do exist in some places, resulting in increased treatment cost for water supplies, damage to sport and commercial fisheries, and undesirable public health and esthetic conditions. Municipal and industrial waste discharges, irrigation return flows, improper land use, and natural disasters have all been contributing factors.

Municipalities and industries produce wastes equivalent to a population of 43.2 million persons. Municipal wastes total about 5.5 million population equivalent (P.E.) and industrial wastes exceed 37.7 million P.E. Of the total, 64 percent is from the pulp and paper industry, 20 percent from the food processing industry, 14 percent from municipal sources, and about 2 percent from wood processing and other industries. Agricultural runoff from both dry and irrigated lands is a significant source of organic and inorganic waste loadings. The rural population and agricultural animals are additional sources of pollution which are significant in localized areas. Natural sources, navigation, dredging, mining, recreation, and dam operations have all caused pollution problems at times in some areas.

In 1965, 539 municipal sewer systems served 3.2 million people or 55 percent of the region's population. Approximately 87 percent or 466 have some type of conventional treatment before discharge including 206 with secondary treatment, 131 with primary treatment, and 129 with lagoons or oxidation ponds.

The Central Snake and Willamette Subregions exhibit the highest waste treatment efficiencies, removing an average of about 85 percent of the oxygen demanding waste load. The lowest levels of treatment are in the Lower Columbia, Upper Snake, and Puget Sound Subregions with average efficiencies of 34, 42, and 44 percent respectively. All other subregions accomplish average reductions between 63 and 78 percent, except the Oregon Closed Basin, which is considered to have 100 percent treatment because the communities use land disposal.

The pulp and paper industry generally provides only minimal treatment, reducing waste loads by about one-quarter. The food processing industry, which achieves a treatment efficiency of about 60 percent, usually has its peak processing season during a period when climatic conditions are favorable for lagoon or land disposal. Wastes from chemical industries generally receive adequate treatment, although accidental spills and phosphate refining discharges have caused serious problems.

In the Yakima and Upper Columbia Subregions, a high level of food processing waste treatment is maintained, while in the Upper Snake, Central Snake, and Mid Columbia improvements are still required. Waste treatment at all pulp and paper operations is in need of improvement. In general, septic tanks and subsurface drainage are used for waste disposal by the rural population. Although the actual waste load reaching waterways is unknown, it is not considered to be large.

Figure 3 depicts the major water quality problem areas of the region.

Water quality Standards have been adopted by each state in the region and are included in Appendix XII, Water Quality and Pollution Control.

Needs

Future waste production and water quality control needs will increase with the projected growth in population, industry, irrigation, agricultural production, and recreation. The present and projected municipal, industrial, rural-domestic, and recreational raw waste loadings are summarized in table 33.

In addition, estimates have been made for livestock raw waste production and summarized in table 34. They are projected to almost equal the combined total of all other sources.

Effective water pollution control will depend on a coordinated regionwide program of waste control and treatment, flow regulation, and land use management. Water quality management programs are timed to meet current state water quality standards and for future time periods, also meet projected higher standards.

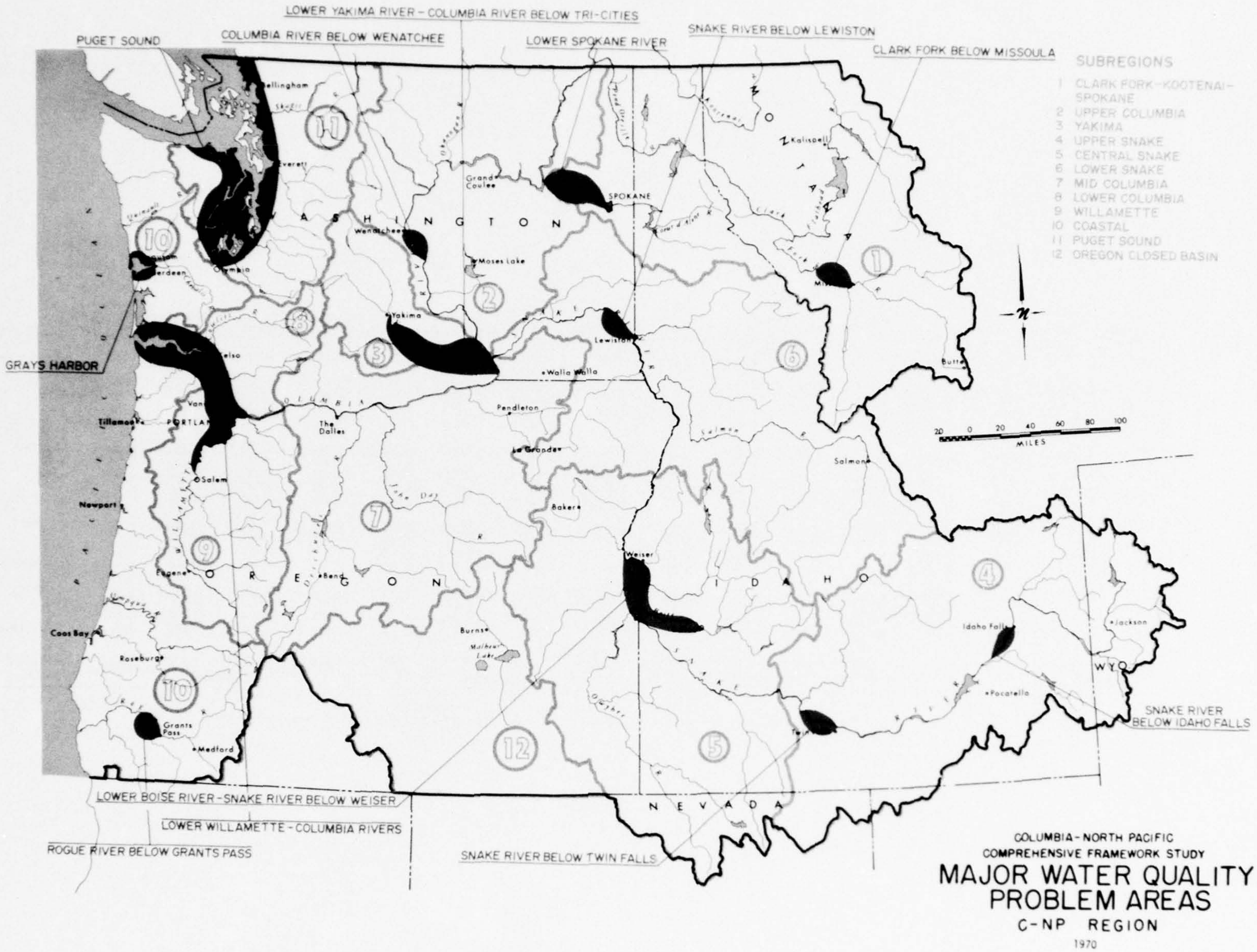

LOWER YAKIMA RIVER - COLUMBIA RIVER BELOW TRI-CITIES
PUGET SOUND
COLUMBIA RIVER BELOW WENATCHEE
LOWER SPOKANE RIVER
SNAKE RIVER BELOW LEWISTON
CLARK FORK BELOW MISSOULA
SUBREGIONS
1 CLARK FORK-KOOTENAI-SPOKANE
2 UPPER COLUMBIA
3 YAKIMA
4 UPPER SNAKE
5 CENTRAL SNAKE
6 LOWER SNAKE
7 MID COLUMBIA
8 LOWER COLUMBIA
9 WILLAMETTE
10 COASTAL
11 PUGET SOUND
12 OREGON CLOSED BASIN
GRAYS HARBOR
WASHINGTON
OREGON
IDAHO
MONTANA
NEVADA
WYO
Bellingham
Everett
Olympia
Wenatchee
Grand Coulee
Moses Lake
SPOKANE
Kalispell
Yakima
Lewiston
Walla Walla
Pendleton
La Grande
Baker
Salem
Newport
Eugene
Bend
Burns
Coos Bay
Roseburg
Grants Pass
Medford
The Dalles
Salmon
Butte
Idaho Falls
Pocatello
Jackson
Weiser
20 0 20 40 60 80 100
MILES
SNAKE RIVER BELOW IDAHO FALLS
LOWER BOISE RIVER - SNAKE RIVER BELOW WEISER
LOWER WILLAMETTE - COLUMBIA RIVERS
ROGUE RIVER BELOW GRANTS PASS
SNAKE RIVER BELOW TWIN FALLS
COLUMBIA - NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY
MAJOR WATER QUALITY
PROBLEM AREAS
C-NP REGION
1970

FIGURE 3

Table 33 - Present and Projected Municipal, Industrial, and Recreation Raw Waste Production, Columbia-North Pacific Region

Area and Subregion	Municipal				Industrial				Recreation				Total			
	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020
							(1,000 pe)									
Area A 1	497.1	620.7	886.2	1,204.2	590.7	792.2	974.8	1,104.5	119.5	162.0	298.0	549.0	1,207.3	1,574.9	2,159.0	2,857.7
2	193.0	241.8	362.6	494.9	2,252.9	3,206.1	5,097.0	7,717.3	76.0	103.0	189.0	345.5	2,521.9	3,550.9	5,648.6	8,557.7
3	137.0	165.6	237.0	331.3	553.2	1,201.5	1,731.9	2,502.1	42.0	57.5	105.5	195.0	732.2	1,424.6	2,074.4	3,028.4
Total	827.1	1,028.1	1,485.8	2,030.4	3,396.8	5,199.8	7,803.7	11,323.9	237.5	322.5	592.5	1,089.5	4,461.4	6,550.4	9,882.0	14,443.8
Area B 4	201.9	265.3	420.0	611.0	3,229.9	4,547.0	6,710.0	8,519.0	90.0	122.5	225.0	414.5	3,521.8	4,934.8	7,355.0	9,544.5
5	211.3	265.7	406.2	575.4	947.7	1,418.0	2,355.0	3,521.0	95.0	128.5	237.0	436.5	1,254.0	1,812.2	2,998.2	4,532.9
6	127.1	154.0	211.0	267.8	534.3	626.2	738.3	831.2	43.5	59.0	108.5	200.5	704.9	839.2	1,057.8	1,299.5
Total	540.3	685.0	1,037.2	1,454.2	4,711.9	6,591.2	9,803.3	12,871.2	228.5	310.0	570.5	1,051.5	5,480.7	7,586.2	11,411.0	15,376.9
Area C 7	157.6	191.2	272.2	364.0	1,508.7	2,030.7	2,672.3	3,472.3	76.0	115.5	213.0	392.0	1,742.3	2,337.4	3,157.5	4,228.3
9	1,678.4	1,915.8	2,699.7	4,103.9	4,506.0	4,141.9	5,954.7	7,652.1	169.4	229.0	428.2	801.2	6,353.8	6,286.7	9,082.6	12,557.2
10S	230.7	277.3	397.6	547.4	1,523.8	2,169.1	2,599.7	2,835.2	151.8	206.5	374.0	700.0	1,906.3	2,652.9	3,371.3	4,082.6
12	6.6	8.6	11.9	15.6	0	0	0	0	8.6	11.0	19.0	34.5	15.2	19.6	30.9	50.1
Total	2,073.3	2,392.9	3,381.4	5,030.9	7,538.5	8,341.7	11,226.7	13,959.6	405.8	562.0	1,034.2	1,927.7	10,017.6	11,296.6	15,642.3	20,918.2
Area D 8	134.2	195.7	306.8	448.0	3,776.2	4,709.5	6,861.0	7,547.5	31.0	43.0	77.5	143.0	3,941.4	4,948.2	7,245.3	8,138.5
10N	81.6	90.0	113.6	137.6	3,909.8	5,629.9	6,791.3	7,454.8	101.2	137.5	259.0	466.0	4,092.6	5,857.4	7,163.9	8,058.4
11	1,929.4	3,183.6	5,118.0	8,208.0	14,334.0	15,008.0	16,454.0	18,886.0	262.6	360.8	696.8	1,351.8	16,526.0	18,552.4	22,268.8	28,445.8
Total	2,145.2	3,469.3	5,538.4	8,793.6	22,020.0	25,347.4	30,106.3	33,888.3	394.8	541.3	1,033.3	1,960.8	24,560.0	29,358.0	36,678.0	44,642.7
Region	5,585.9	7,575.3	11,442.8	17,309.1	37,667.2	45,480.1	58,940.0	72,043.0	1,266.6	1,735.8	3,230.5	6,029.5	44,519.7	54,791.2	73,613.3	95,381.6

Source: Appendix XII, Water Quality and Pollution Control, and comprehensive water and related land resource studies of Willamette River Basin (Subregion 9) and Puget Sound & Adjacent Waters (Subregion 11), adjusted to 1970.

Reduction of pollution loads to receiving streams can be accomplished by either reducing the amounts of wastes generated or raising the level of treatment. Waste production can be reduced by recovery practices in the production process. As waste treatment processes to remove all pollutants are limited by costs, the dilution capacity of the receiving waters must be relied on partially for maintenance of quality.

Table 34 - Projected Livestock Raw Organic Waste Production
Columbia-North Pacific Region

Subregion	1980	2000	2020
		(millions p.e.)	
1	4.2	5.5	7.3
2	4.4	5.9	7.7
3	3.4	4.5	5.9
4	8.8	12.0	15.8
5	7.9	10.5	13.8
6	4.2	5.6	7.4
7	5.7	7.6	10.0
8	1.5	2.3	3.1
9	3.0	4.0	5.2
10	1.4	1.8	2.4
11	3.8	5.0	6.6
12	1.3	1.8	2.3
Region	49.6	66.5	87.5

Source: Appendix XII, Water Quality and Pollution Control.

Particular needs for water quality and pollution control are:

Water Quality Problem	Needed Control Measures
Municipal Wastes	Collection and treatment to remove 85 percent of organic materials by 1980; 90 percent by the years 2000 and 2020.
	In critical areas advanced treatment to remove salts and nutrients, and additional organic materials.
	Consider ocean outfalls in preference to estuaries for discharge of treated wastes.
Industrial wastes	Process controls, water reuse, or recycling to reduce waste-water discharges to minimum levels.
	Treatment to remove 85 percent of organic material by 1980; 90 percent by years 2000 and 2020.
	Higher treatment as necessary in critical areas.
Rural wastes	Septic tanks and drain fields.
	Alternative disposal methods such as unified community treatment, developed on a cooperative basis, where contamination of ground water or nearby streams and reservoirs by septic tank drainage is likely.
Recreation area and watercraft wastes	Sanitary sewage disposal systems designed to accommodate peak weekend loads.
	Sanitary waste treatment or holding facilities on watercraft.

Water Quality Problem	Needed Control Measures
	Facilities at launching sites and marinas to receive contents of boat holding tanks.
Irrigation waste water	More efficient conveyance systems and on-farm application methods through improved farm water management plans.
	Detention basins at stream discharge points.
	Additional treatment and/or control in critical areas.
Feedlot wastes	Locate away from streams and design so that uncontrolled surface drainage does not enter basin waters.
	Collection and treatment systems as required.
Land runoff	Utilize accepted erosion-control practices in agricultural, logging, and construction operations to minimize the transport of sediments, fertilizers and pesticides to receiving waters. Details are found in the Land Measures part of the plan.
	Control use of fertilizers and commercial toxicants to minimize the amounts occurring in land runoff.
	Employ natural control agents in place of chemical pesticides where appropriate.
Algae	Detailed studies to identify the origin of nutrients and their point of entry into surface waters.
	Definition of areas where nutrient control can be accomplished through advanced treatment of collectible wastes.

Water Quality Problem	Needed Control Measures
	Research into other methods of algae control.
Thermal discharges	Maintain cooling water discharges from thermal power plants at temperatures compatible with state water quality standards.
	Alternative uses of cooling water discharge such as irrigation or utilize for preheated industrial water processes.
Storage reservoirs	Flow releases for downstream water quality control.
	Multilevel outlets to regulate temperatures and dissolved oxygen content of reservoir releases.
	Facilities to aerate reservoir releases.
	Reregulating reservoirs to level out peak power releases.
	Reservoir destratification devices, where needed.

RECREATION

General

The region's outdoor recreational opportunities range from areas of wilderness to urban parks; from high deserts and even higher mountains to river valleys and ocean shores. Many of the Nation's most outstanding natural outdoor recreation attractions are found here. These include over 2.5 million acres of water surface, more than 10,000 miles of potential, wild, scenic, and free-flowing rivers; 3,000 miles of ocean, sound, and estuary shoreline; and nearly 20 million acres of special recreation attractions. About 60 percent of the region's land base, or 105 million acres, is in public ownership. Most of this land will continue to be available for outdoor recreation and other public uses in the foreseeable future.

Cover types and their distribution play an important part in the availability and characteristics of the recreation attractions. Forest types, which constitute 86 million acres, include dense stands of Douglas-fir in the Coast and Cascade Ranges, mixed fir and pine in the Rocky Mountains, and open stands of ponderosa pine in the central part of the region. Rangeland, which occupies 50 million acres, is found mostly as grassland in the central plateaus and as desert-sage lands in the south and southeast. The 21 million acres of cropland are located principally in the plateau and valley areas. The barren, urban, and industrialized lands make up the balance; the barren offering some of the most scenic attractions.

Associated with the other natural resources is the great variety of fish and wildlife species, which provide many opportunities for hunting, fishing, or wildlife observation and study. In addition, there are many historical and archaeological sites scattered throughout the region.

Recreation activity totaled nearly 200 million visitor-days in calendar year 1965. About 40 percent of this was either water contact (e.g. swimming, boating, water skiing) or water oriented (e.g. camping, picnicking in a water setting) activity. Water-related and total recreation uses, by subregion, are shown in table 14.

Needs

Both the region and the Nation have experienced a phenomenal increase in recreation use and there is ample evidence that it will continue. This increase is due to a combination of factors, including increases in income, leisure time, mobility, additional facility development, and improved access to recreation resources. Projected water-related demands, in terms of recreation days are summarized on table 35 along with estimated 1970 use. Present use is somewhat less than the demand due to lack of facility development in some areas, lack of access to certain water areas, and a geographical imbalance between facility development and needs. Residual needs shown in the table reflect the additional requirements that must be satisfied to fully meet demand by the years 1980, 2000, and 2020. Surveys indicate water-related activities will continue to be among the fastest growing of all summertime activities.

The overriding problem associated with outdoor recreation resources is that of achieving a proper balance between their use and their protection. Factors which must be considered are: (1) competition for water-related lands, (2) competition for use for free-flowing streams, (3) competition between recreation uses,

Table 35 - Present Use and Projected Water-related Recreation Needs
Columbia-North Pacific Region

Subregion	1970	1980	2000	2020
	(recreation days in millions)			
Area A 1	6.4	11.7	22.3	40.9
2	6.5	7.4	14.1	25.9
3	3.0	4.5	7.9	14.5
Total	15.9	23.6	44.3	81.3
Area B 4	5.9	8.8	16.8	30.9
5	4.8	8.7	17.7	32.5
6	3.2	4.6	8.2	15.0
Total	13.9	22.1	42.7	78.4
Area C 7	5.5	8.4	15.9	29.2
9	14.3	23.5	36.7	60.6
10S	10.3	14.9	28.3	52.0
12	.3	.7	1.4	2.6
Total	30.4	47.5	82.3	144.4
Area D 8	1.5	3.0	5.8	10.6
10N	6.9	9.9	19.0	34.8
11	20.7	33.1	77.4	161.7
Total	29.1	46.0	102.2	207.1
Region	89.3	139.2	271.5	511.2

Source: Appendix XIII, Recreation, and Comprehensive Water and Related Land Resource Studies of Willamette River Basin (Subregion 9) and Puget Sound & Adjacent Waters (Subregion 11), adjusted to 1970 except as noted.

(4) overuse and misuse of resources, (5) vandalism, (6) pollution from recreation, and (7) financial capabilities and opportunities of all levels of government, especially local.

Two basic programs are needed. The first involves keeping existing resources available for outdoor recreation use. This will require the preservation and maintenance of existing supply, including areas presently managed as wilderness and national parks, free-flowing rivers, and other public use areas. The second relates to the development of recreation resources within their capacities to support both the resident population and increased tourist use. This will require both the development of existing areas to their full carrying capacity and the addition of additional areas as the need arises. An adequate supply of land and water is available to meet projected needs. However, location and accessibility of the supply are not always optimum. Land requirements include associated land needed for camping, picnicking, swimming beaches, boat launching, parking areas, and unoccupied buffer zones or landscape areas. There is a need for expansion of undeveloped areas in addition to developed sites. Every effort should be made to set aside unique features of the landscape. The more interesting natural, archeological, and historical areas should be identified, classified, protected, and interpreted through both Federal and State systems.

FISH AND WILDLIFE

General

Fish and wildlife include anadromous fish, resident fish, marine fish and shellfish, big game, upland game, fur bearing animals, waterfowl, and other wildlife. Species of resident fish and all wildlife groups inhabit every subregion. Marine fish and shellfish are limited to the Coastal and Puget Sound Subregions.

Fish habitat in lakes and reservoirs is ample although of variable quality. Summer range for deer and elk, the principal big game species, is abundant in most areas, but winter range is critical. Upland game habitat, though diminishing, is not critical, except in localized areas of intensive use. The region's many bays, estuaries, marshes, shallow lakes, and streams provide waterfowl habitat important for wintering, nesting, and resting during migrations.

Estimates of present sport fishing and hunting in user days and pounds of commercial fish harvest are shown in table 15. These estimates reflect 1965 data.

Fish

Anadromous fish inhabit nearly all accessible rivers and streams tributary to the Pacific Ocean, Puget Sound, and the Columbia River. The most important of these are the salmon and searun trout. Factors limiting production include pollution, high water temperatures, low flows, siltation, lack of spawning ground, competition with other fish, and barriers to upstream migration. Many streams which historically supported runs are now inaccessible because of man-caused obstructions. Fluctuations of flows from peaking dams on Columbia River for power may cause future problems. The recently discovered problem of nitrogen supersaturation in the Columbia and lower Snake Rivers is perhaps the most serious current problem.

Trout and char are the most highly regarded resident fish. Rainbow trout are the most numerous with many raised commercially and millions planted annually from public hatcheries to supplemtnt natural production. Streams, lakes, ponds, and reservoirs located in lower elevations support warm water game fish, including several catfish species, largemouth and smallmouth bass, sunfish, crappies, yellow perch, and walleyes, all of which were introduced. Low natural fertility limits production of resident fish in many lakes and streams, particularly west of the Cascades. Low seasonal flows and water levels limit production and use of some waters. Pollution and poor water quality are detrimental in many water areas, and diseases or parasites may be limiting in some waters. Poor access, due in part to private land ownership barriers, restricts use of resident fish.

Marine fish and shellfish are abundant off the Oregon-Washington coast and in bays and estuaries. Fragile estuarine ecosystems are subject to pollution, siltation and other pollutants from coastal rivers, and have been dredged, filled and used as garbage dumps and septic tanks. The presence or absence of cover such as supplied by kelp beds, wrecks, piers, and jetties affects species and numbers of bottomfish. Beach erosion and a sand deposition may destroy shellfish beds and predators limit production of oysters in many areas.

Wildlife

Big game resources include Rocky Mountain and Roosevelt elk; moose; black-tailed, white-tailed, and mule deer; pronghorn antelope; big horn sheep; Rocky Mountain goat; mountain caribou; black and grizzly bears; and mountain lion. Two major factors influencing big game habitat are logging operations and forest fires. Excellent habitat exists for 15 to 20 years following either, but thereafter habitat values decrease until the forest

is again cut or burned. Both overharvest and underharvest affect big game production, but strict regulation makes overharvest a problem only in very localized areas. Underharvest is a problem in some areas although improvement in management, increased hunting accessibility and techniques for better harvest distribution have improved this situation. Usually the problem results from an imbalance in summer and winter range. Normally low elevation winter range has greater competitive uses conflicting with wildlife and leading to decreases in big game population. Disease and parasites, usually related to nutrition, sometimes limit big game population. Predators may influence population levels. Water developments have inundated important winter ranges in some areas and created barriers to migration.

Upland game includes many native and introduced species. Most upland game species are very short-lived and capable of rapid reproduction. Overhunting rarely causes population declines and numbers may fluctuate widely, year to year or season to season, without observable changes in environment. More intensive land use and developments of all kinds have eliminated much habitat. This has resulted in hunting restrictions on other habitat areas not physically affected by the expansion.

Fur bearing animals inhabit almost all areas in the region and support a commercial fur industry. Events affecting waterfowl and upland game resources also usually affect fur animal resources.

Waterfowl in the region includes many species; some year-long residents, some nesters, and some migrators and winter residents. As most waterfowl migrate, they are also affected by drainage of wetlands, and flooding of habitat along their migration routes. Neither drainage nor flooding has been a serious overall problem in the region although there have been considerable waterfowl habitat losses from agricultural drainage in Subregions 8, 9, and 11, and loss of Canada goose nesting habitat from reservoir construction on the Columbia River. Exceptions are waterfowl habitat developed in conjunction with the Columbia Basin project in Washington, certain reservoirs in southern Idaho, and McKay, Cold Springs, and Fern Ridge Reservoirs in Oregon. Waterfowl nest predation limits production in some areas, particularly where habitat is deteriorating.

Other wildlife species include jackrabbits, fox, coyote; rodents except beaver, muskrats, squirrels, and nutria; unprotected rapacious and nuisance birds; most reptiles and amphibians; nongame birds; feral pigeons, cats, pigs, and goats; seals and sea lions; and other animals not otherwise categorized. These animals are valuable mostly for viewing, although some are harvested for food, sport, or pelts. Hunting use of these species is measured although about 10 percent of all hunter use is usually estimated

for nongame species. Natural limitiations, man-caused problems, and beneficial developments affecting other faunal groups also influence "other" wildlife resources.

Needs

Future needs for fish and wildlife resources include continuation of existing programs and practices for habitat preservation and enhancement, and initiation of new policies and programs for optimum development, management, and use of these resources. Recreational and commercial needs will increase substantially between 1970 and 2020, requiring an increase in fish and wildlife populations along with protection and improvement of existing habitat.

Sport fishing demand is expected to increase 200 percent from about 21.3 million user-days to 64.1 million, an additional need of 42.8 million user-days between 1970 and 2020. Hunting demand will increase about 125 percent from some 10.5 million user-days in 1970 to 23.6 million by 2020, giving additional needs of around 13.1 million user-days. These additional sport fishing and hunting needs are shown in table 36 for each of the three future time periods by area and subregion. Demand for commercial fish harvest is projected to increase from about 183.4 million pounds landed in 1970 to 466.7 million pounds by 2020, an additional need of some 283.3 million pounds. These needs are presented in table 37.

The projections do not include activities such as wildlife observations and photography, for which data are unavailable but which represent a substantial current use that will increase significantly. There is a specific need to protect the endangered species of wildlife for the publics' continued interest and enjoyment. Visitor-use associated with wildlife-viewing may be as important as use by hunters and fishermen.

Considerable research and study are needed to more accurately evaluate needs for these resources. Better guides are needed to determine fish and wildlife populations required relative to man's needs, and to translate those results into requirements for habitat protection and improvement. Additional standards and guidelines are seriously needed to develop quantitative support data for fish and wildlife resources which will assure their equal consideration with other natural resources in future planning and development efforts.

Additional legislation to further fish and wildlife conservation and enhancement is also needed. To insure future hunting, fishing, and esthetic enjoyment, fish and wildlife must be given the equal consideration afforded other project affected interests.

Fishing

Increased numbers or size of fish, more intensive use of some species, and the provision of more fishing areas are required. Of major importance will be habitat preservation, restoration, improved access to fishing areas, and artificial stock progagation. Improved harvesting techniques and removal of institutional barriers to aquaculture are other needs.

The quality of fishing should be retained at least at the current level. To meet this objective means that as much of the habitat as possible must be maintained and management techniques continue to be improved. When considered in the best public interest, special habitat characteristics should be preserved to retain the type of angling only free-flowing streams provide. The physical character of these streams (bottom materials, meandering course, and bank vegetation) along with the quantity and quality of flow must be retained or enhanced. Major river systems and many of their tributaries should be managed to permit natural propagation of anadromous and resident fish. Estuarine areas also should be managed with habitat enhancement as an objective.

Stream barriers such as logjams and impassable falls and culverts should be removed or fish passage facilities should be provided to increase the amount of spawning area available to anadromous fish. Passage facilities at a number of these obstructions would also benefit resident fish. Pollution of water should be abated to improve water quality and increase fish production. Increased or regulated flows in many streams will restore, improve, or maintain habitat. Gradient-reducing devices should be installed in some streams. In some subregions small fishing impoundments should be constructed where they would not eliminate existing stream fisheries or wildlife values. Other measures that should be implemented where appropriate include: chemical control of undesirable fish, development of spawning beds in streams, fertilization of some lakes, introduction of beneficial aquatic plants and food organisms, construction of fish shelters (such as brush piles), removal of debris, and control of aquatic weeds.

Existing stocks of anadromous fishes and resident salmonids are being used nearly to capacity. The harvest could be increased only during years or abundant migrations by increasing the length of seasons or liberalizing other regulations. Providing additional access would help to satisfy some of the increasing need for other species.

One of the primary means for increasing production of anadromous fish in the future will be artifical propagation.

Table 36 - Projected Sport Fishing and Hunting Needs
Columbia-North Pacific Region

Area and Subregion	Use	Present 1970	Incremental Needs 1970-1980	Incremental Needs 1981-2000	Incremental Needs 2001-2020	Total 1970-2020
			(1,000 user-days)			
Area A						
Subregion 1	Fishing	1,510	589	694	831	2,114
	Hunting	825	161	279	342	782
	Total	2,335	750	973	1,173	2,896
Subregion 2	Fishing	2,746	1,084	1,241	1,544	3,869
	Hunting	1,369	340	570	699	1,609
	Total	4,115	1,424	1,811	2,243	5,478
Subregion 3	Fishing	781	314	355	441	1,110
	Hunting	619	151	253	310	714
	Total	1,400	465	608	751	1,824
Totals	Fishing	5,037	1,987	2,290	2,816	7,093
	Hunting	2,813	652	1,102	1,351	3,105
	Total	7,850	2,639	3,392	4,167	10,198
Area B						
Subregion 4	Fishing	705	275	317	395	987
	Hunting	940	166	285	345	796
	Total	1,645	441	602	740	1,783
Subregion 5	Fishing	610	238	274	342	854
	Hunting	1,087	226	389	474	1,089
	Total	1,697	464	663	816	1,943
Subregion 6	Fishing	862	394	414	502	1,310
	Hunting	1,419	330	562	687	1,579
	Total	2,281	724	976	1,189	2,889
Totals	Fishing	2,177	907	1,005	1,239	3,151
	Hunting	3,446	722	1,236	1,506	3,464
		5,623	1,629	2,241	2,745	6,615

Table 36 - Continued

Area and Subregion	Use	Present 1970	Incremental Needs 1970-1980	1981-2000	2001-2020	Total 1970-2020
			(1,000 user-days)			
Area C						
Subregion 7	Fishing	1,117	459	510	637	1,606
	Hunting	1,022	257	440	542	1,239
	Total	2,139	716	950	1,179	2,845
Subregion 9	Fishing	1,204	557	618	949	2,124
	Hunting	854	225	491	337	1,053
	Total	2,058	782	1,109	1,286	3,177
Subregion 10S	Fishing	2,435	1,372	1,238	1,556	4,166
	Hunting	492	125	215	267	607
	Total	2,927	1,497	1,453	1,823	4,773
Subregion 12	Fishing	129	50	58	73	181
	Hunting	158	40	70	86	196
	Total	287	90	128	159	377
Totals	Fishing	4,885	2,438	2,424	3,215	8,077
	Hunting	2,526	647	1,216	1,232	3,095
		7,411	3,085	3,640	4,447	11,172
Area D						
Subregion 8	Fishing	890	417	424	531	1,372
	Hunting	405	101	171	209	481
	Total	1,295	518	595	740	1,853
Subregion 10N	Fishing	2,636	1,360	1,296	1,626	4,282
	Hunting	456	118	199	243	560
	Total	3,092	1,478	1,495	1,869	4,842
Subregion 11	Fishing	5,721	3,768	5,756	9,301	18,825
	Hunting	858	777	1,016	620	2,413
	Total	6,579	4,545	6,772	9,921	21,238
Totals	Fishing	9,247	5,545	7,476	11,458	24,479
	Hunting	1,719	996	1,386	1,072	3,454
		10,966	6,541	8,862	12,530	27,933
Region	Fishing	21,346	10,877	13,195	18,728	42,800
	Hunting	10,504	3,017	4,940	5,161	13,118
	Total	31,850	13,894	18,135	23,889	55,918

Source: Appendix XIV, Fish and Wildlife, and comprehensive water and related land resource studies of Willamette River Basin (Subregion 9) and Puget Sound & Adjacent Waters (Subregion 11), adjusted to 1970.

Table 37 - Projected Commercial Fishing Needs
Columbia-North Pacific Region

Area and Subregion	Type	Present Use 1970	Incremental Needs 1970-1980	Incremental Needs 1981-2000	Incremental Needs 2001-2020	1970-2020
			(thousands of pounds)			
Area A	Anadromous Fish	0	0	0	0	0
	Marine Fish	0	0	0	0	0
	Shellfish	0	0	0	0	0
	Total	0	0	0	0	0
Area B	Anadromous Fish	0	0	0	0	0
	Marine Fish	0	0	0	0	0
	Shellfish	0	0	0	0	0
	Total	0	0	0	0	0
Area C						
Subregion 7	Anadromous Fish	0	0	0	0	0
	Marine Fish	0	0	0	0	0
	Shellfish	0	0	0	0	0
	Total	0	0	0	0	0
Subregion 9	Anadromous Fish	0	0	0	0	0
	Marine Fish	0	0	0	0	0
	Shellfish	0	0	0	0	0
	Total	0	0	0	0	0
Subregion 10S	Anadromoush Fish	10,556	7,599	5,913	7,494	21,006
	Marine Fish	6,462	2,519	2,908	3,583	9,010
	Shellfish	3,856	1,504	1,736	1,890	5,130
	Total	20,874	11,622	10,557	12,967	35,146
Subregion 12	Anadromoush Fish	0	0	0	0	0
	Marine Fish	0	0	0	0	0
	Shellfish	0	0	0	0	0
	Total	0	0	0	0	0
Totals	Anadromoush Fish	10,556	7,599	5,913	7,494	21,006
	Marine Fish	6,462	2,519	2,908	3,583	9,010
	Shellfish	3,856	1,504	1,736	1,890	5,130
		20,874	11,622	10,557	12,967	35,146
Area D						
Subregion 8	Anadromous Fish	2,753	1,983	1,540	1,955	5,478
	Marine Fish	0	0	0	0	0
	Shellfish	0	0	0	0	0
	Total	2,753	1,983	1,540	1,955	5,478
Subregion 10N	Anadromous Fish	14,435	10,392	8,085	10,248	28,725
	Marine Fish	31,547	12,304	14,197	17,489	43,990
	Shellfish	16,440	6,412	7,397	8,061	21,870
	Total	62,422	29,108	29,679	35,798	94,585
Subregion 11	Anadromous Fish	17,025	12,256	9,536	12,088	33,880
	Marine Fish	73,610	28,708	33,124	41,435	103,267
	Shellfish	6,757	2,635	3,041	5,198	10,874
	Total	97,392	43,599	45,701	58,721	148,021
Totals	Anadromous Fish	34,213	24,631	19,161	24,291	68,083
	Marine Fish	105,157	41,012	47,321	58,924	147,257
	Shellfish	23,197	9,047	10,438	13,259	32,744
	To	162,567	74,690	76,920	96,474	248,084
Region	Anadromous Fish	44,769	32,230	25,074	31,785	89,089
	Marine Fish	111,619	43,531	50,229	62,507	156,267
	Shellfish	27,053	10,551	12,174	15,149	37,874
	Total	183,441	86,312	87,477	109,441	283,230

Source: Appendix XIV, Fish & Wildlife and comprehensive water and related land resource studies of the Willamette River Basin (Subregion 9) and Puget Sound & Adjacent Waters (Subregion 11), adjusted to 1970.

Hatcheries, incubation channels, and spawning channels will become more and more important as the demand increases.

Hunting

Habitat preservation and habitat improvement are needed to sustain and increase natural production. Greater harvest of the existing resource is required to obtain more hunting than now realized. Augmentation of the supply could make use of such means as artifical propagation and artificial feeding.

Preservation of key habitat is of major importance in satisfying the present level of use and providing a habitat base. Multiple-purpose planning should consider zoning and green belt concepts to prevent intensive development which might destroy key habitat.

Habitat preservation for deer and elk is needed most on low-elevation winter range which is usually the limiting factor for these species. Pronghorn antelope have specific summer and winter ranges plus vital "fawning" areas that should be protected. Preservation of wilderness type habitat is vital to retaining present numbers of mountain goat, mountain lion, bighorn sheep, moose, and grizzly bear.

Wildlife management agencies cannot significantly control activities that threaten upland game. Consequently, major efforts should be made to encourage landowners to preserve and enhance habitat, especially critical habitat such as "pigeon springs," nesting areas, and critical winter cover.

It is very important that key waterfowl areas be protected from drainage and landfill. Some species, such as mallard and pintail, are grain feeders; therefore, cereal grain production, which is an integral part of winter carrying capacity, should be maintained to retain migration and wintering patterns that provide present hunting conditions. Water resource development will be instrumental in preserving waterfowl habitat if prime water habitat is obtained as a project purpose. Projects involving channel straightening should allow oxbows to retain water and natural vegetation. Riprapping, dikes, and concrete channels may destroy waterfowl habitat. The major need for habitat improvement for deer and elk occurs on winter ranges where the quantity and/or quality of food plants has been reduced. Opportunities for upgrading winter ranges are: (1) Ecological manipulations; (2) timber management for big game; (3) browse "farming"; (4) zoning for big game; (5) control of livestock grazing; (6) use of mechanical devices to prevent game losses.

Suggested upland game habitat manipulation would also benefit waterfowl. Measures that should be undertaken specifically for waterfowl are under the following three headings: food, water, and cover.

In the future, increases in hunting will depend partially upon harvest of a higher percentage of game population. This will require specific management practices such as special or controlled hunts, and improving access on presently restricted areas.

Comprehensive water resource programs could provide opportunities for better access by granting hunters right-of-way over project lands, acquiring easements for hunters over private lands adjacent to projects, or by acquiring or leasing lands adjacent to projects to eliminate private ownership problems.

Augmentation of supply will become increasingly important in future years as hunting needs increase and the quality and quantity of wildlife habitat are reduced. Satisfying future hunting needs will require a number of programs to increase the amount of wildlife on accessible hunting areas. Artificial propagation of upland game, especially pheasants, will become more extensive. Exotic species may be introduced if researchers find adaptable and compatible species. Native species should be tranplanted if local problems can be solved.

Artificial feeding of upland game and waterfowl during severe winters (about 5-year frequencies) would be helpfull. Without adequate brood stock survival, natural production may be greatly diminished.

Under certain conditions, feeding big game herds is also a usable management technique. Where low-lying big game winter ranges are limited, feeding may be necessary. Potential benefits from big game feeding programs include: (1) lessening of population fluctuations, (2) reduction in competition between livestock and elk and deer for browse, and (3) public acceptance of either-sex harvest season concept (normally suspended for several years following a decimating winter).

ELECTRIC POWER

The Columbia-North Pacific Region's electric power needs, which totaled 102,641 million kilowatt-hours in 1970, are being served through an interconnected, coordinated system based almost entirely on hydrogeneration. However, a substantial part of the economical conventional hydro sites will soon be developed and the region will have to turn to thermal and pumped-storage

Table 38 - System Capacities of Electric Power Projects Existing, Under Construction, and Aut
Columbia-North Pacific Region

Class Utility	Hydro							
	Existing		Construction		Authorized or Licensed		Total	
	No. of Plants	Nameplate Rating-kw	No. of Plants	Nameplate Rating-kw	No. of Plants	Nameplate Rating-kw	No. of Plants	Namepl Rating
Federal								
Bureau of Indian Affairs	1	360	0	0	0	0	1	
Bureau of Reclamation	1	16,000	0	0	0	0	1	16,
Columbia River Power System	25	8,496,150	6	7,263,000	2	5,479,880	33	21,239,
National Park Service	1	800	0	0	0	0	1	
Navy Yard	0	0	0	0	0	0	0	
Wapato Irrigation District	2	3,360	0	0	0	0	2	3,
Total Federal	30	8,516,670	6	7,263,000	2	5,479,880	38	21,259,
Non-Federal								
Public								
Baker, City of	1	120	0	0	0	0	1	
Bonners Ferry, City of	2	2,380	0	0	0	0	2	2,
Centralia, City of	1	9,000	0	0	0	0	1	9,
Chelan County PUD	4	971,850	0	501,600	0	398,000	4	1,871,
Cowlitz County PUD	1	70,000	0	0	0	0	1	70,
Douglas County PUD	1	774,250	0	0	0	0	1	774,
Eugene, City of	4	111,500	0	0	0	0	4	111,
Fall River Rural Electric Coop.	1	1,870	0	0	0	0	1	1,
Grant County PUD	2	1,619,750	0	0	0	971,850	2	2,591,
Grays Harbor County PUD	0	0	0	0	0	0	0	
Idaho Falls, City of	3	7,400	0	0	0	0	3	7,
Lower Valley Power & Light, Inc.	3	2,900	0	0	0	0	3	2,
McMinnville, City of	0	0	0	0	0	0	0	
Orcas Power & Light Coop.	0	0	0	0	0	0	0	
Pend Oreille County PUD	2	60,560	0	0	0	0	2	60,
Seattle, City of	5	1,188,256	1	2,000	0	395,500	6	1,585,
Snohomish County PUD	0	0	0	0	3	140,000	3	140,
Spokane, City of	1	3,900	0	0	0	0	1	3,
Tacoma, City of	6	659,700	0	0	0	190,500	6	850,
Washington Public Power Supply System	1	26,125	0	0	0	0	1	26,
Total Public	38	5,509,561	1	503,600	3	2,095,850	42	8,109,
Private2/								
Atlanta Power Co.	1	150	0	0	0	0	1	
California-Pacific Utilities Co.	1	800	0	0	0	0	1	
Clearwater Power Co.	0	0	0	0	0	0	0	
Idaho Power Co.	17	1,289,345	0	0	0	398,200	17	1,687,
Montana Light & Power Co.	2	4,500	0	0	0	0	2	4,
Montana Power Co.	4	202,140	0	0	0	0	2	202,
Pacific Power & Light Co.	28	712,747	0	0	0	153,000	28	865,
Portland General Electric Co.	8	534,350	0	0	0	25,500 1/	8	559,
Puget Sound Power & Light Co.	7	290,690	0	0	0	114,600	7	405,
Utah Power & Light Co.	2	6,300	0	0	0	0	2	6,
Washington Water Power Co.	10	636,530	0	0	0	70,720	10	707,
Western Light & Power Co.	2	1,150	0	0	0	0	2	1,
Total Private	82	3,678,702	0	0	0	762,020	82	4,440,
Total Non-Federal	120	9,188,263	1	503,600	3	2,857,870	124	12,549,
Total Columbia-North Pacific	150	17,704,933	7	7,766,600	5	8,337,750	162	33,809,

1/ Application to Federal Power Commission pending for abandonment of license.
2/ Listed according to Federal Power Commission records, does not reflect all changes in company names.
Source: Appendix XV, Electric Power.

ies of Electric Power Projects Existing, Under Construction, and Authorized or Licensed, December 31, 1969
Columbia-North Pacific Region

Hydro							Thermal		Total Existing		Grand Total	
ing	Construction		Authorized or Licensed		Total		Existing					
ameplate ating-kw	No. of Plants	Nameplate Rating-kw	No. of Plants	Nameplate Rating-kw	No. of Plants	Nameplate Rating-kw	No. of Plants	Name Rating-kw	No. of Plants	Nameplate Rating-kw	No. of Plants	Nameplate Rating-kw
360	0	0	0	0	1	360	0	0	1	360	1	360
16,000	0	0	0	0	1	16,000	0	0	1	16,000	1	16,000
.496,150	6	7,263,000	2	5,479,880	33	21,239,030	0	0	25	8,496,150	33	21,239,030
800	0	0	0	0	1	800	6	562	7	1,362	7	1,362
0	0	0	0	0	0	0	1	18,000	1	18,000	1	18,000
3,360	0	0	0	0	2	3,360	0	0	2	3,360	2	3,360
,516,670	6	7,263,000	2	5,479,880	38	21,259,550	7	18,562	37	8,535,232	45	21,278,112
120	0	0	0	0	1	120	0	0	1	120	1	120
2,380	0	0	0	0	2	2,380	1	240	3	2,620	3	2,620
9,000	0	0	0	0	1	9,000	0	0	1	9,000	1	9,000
971,850	0	501,600	0	398,000	4	1,871,450	1	150	5	972,000	5	1,871,600
70,000	0	0	0	0	1	70,000	1	26,640	2	96,640	2	96,640
774,250	0	0	0	0	1	774,250	0	0	1	774,250	1	774,250
111,500	0	0	0	0	4	111,500	1	26,875	5	138,875	5	138,875
1,870	0	0	0	0	1	1,870	0	0	1	1,870	1	1,870
,619,750	0	0	0	971,850	2	2,591,600	0	0	2	1,619,750	2	2,591,600
0	0	0	0	0	0	0	1	12,500	1	12,500	1	12,500
7,400	0	0	0	0	3	7,400	1	2,500	4	9,900	4	9,900
2,900	0	0	0	0	3	2,900	3	1,560	6	4,460	6	4,460
0	0	0	0	0	0	0	1	2,740	1	2,740	1	2,740
0	0	0	0	0	0	0	2	2,310	2	2,310	2	2,310
60,560	0	0	0	0	2	60,560	0	0	2	60,560	2	60,560
188,256	1	2,000	0	395,500	6	1,585,756	2	51,000	7	1,239,256	8	1,636,756
0	0	0	3	140,000	3	140,000	0	0	0	0	3	140,000
3,900	0	0	0	0	1	3,900	0	0	1	3,900	1	3,900
659,700	0	0	0	190,500	6	850,200	2	59,000	8	718,700	8	909,200
26,125	0	0	0	0	1	26,125	1	800,000	2	826,125	2	826,125
509,561	1	503,600	3	2,095,850	42	8,109,011	17	985,515	55	6,495,076	59	9,094,526
150	0	0	0	0	1	150	0	0	1	150	1	150
800	0	0	0	0	1	800	0	0	1	800	1	800
0	0	0	0	0	0	0	1	493	1	493	1	493
289,345	0	0	0	398,200	17	1,687,545	1	6,825	18	1,296,170	18	1,694,370
4,500	0	0	0	0	2	4,500	2	15,550	4	20,050	4	20,050
202,140	0	0	0	0	2	202,140	0	0	4	202,140	4	202,140
712,747	0	0	0	153,000	28	865,747	5	65,300	33	778,047	33	931,047
534,350	0	0	0	25,500 1/	8	559,850	1	75,500	9	609,850	9	635,350
290,690	0	0	0	114,600	7	405,290	2	90,000	9	380,690	9	495,290
6,300	0	0	0	0	2	6,300	0	0	2	6,300	2	6,300
636,530	0	0	0	70,720	10	707,250	0	0	10	636,530	10	707,250
1,150	0	0	0	0	2	1,150	0	0	2	1,150	2	1,150
678,702	0	0	0	762,020	82	4,440,722	12	253,668	94	3,932,370	94	4,694,390
188,263	1	503,600	3	2,857,870	124	12,549,333	29	1,239,183	149	10,427,446	153	13,788,916
704,933	7	7,766,600	5	8,337,750	162	33,809,283	36	1,257,745	186	18,962,678	198	35,067,028

abandonment of license.
s, does not reflect all changes in company names.

9

sources to meet needs, projected to reach 1,286,000 million kilowatt-hours in 2020.

Because of interutility contracts, transmission interconnections, and hydraulic interrelations, the power resources and needs of the region must be regarded as a unit for both operating and planning purposes. Coordination is currently being accomplished by multiple voluntary organizations of govermental agencies and public and private utilities in both the United States and Canada. It is based on several interrelated agreements, treaties, and authorities, and provides for optimum use of facilities to meet needs and for planning future facilities. Details are included in Appendix XV, Electric Power.

Existing Power Facilities

Generation

The existing (December 31, 1969) power generating capability, totals 18,962.7 megawatts, comprising 17,704.9 megawatts of hydro and 1,257.8 megawatts of thermal, table 38. Nearly half (8,516.7 MW) of the existing capacity is installed at Federal multipurpose hydroelectric projects of which all but a few minor plants are part of the Federal Columbia River Power System. Non-Federal public agencies have a total generating capacity of 6,495.1 megawatts, and private utilities have 3,932.4 megawatts. With the exception of the 800-megawatt Hanford nuclear plant, most of the thermal capacity is old and used only as reserves.

Additional generating capacity under construction includes 7,766.6 megawatts of hydro and 1,400 megawatts of thermal. Most of the hydro will be developed by expansion at existing sites. The thermal comprises a coal-fired plant near Centralia, Washington.

The firm energy load carrying capability for the 1969-70 contract year by generating utilities throughout the region was 12,340 megawatts. Based on a critical water year the total firm peaking capability for projects existing and under construction was 21,526 megawatts in January 1970.

Transmission

A vast network of transmission circuits links generating plants to load centers throughout the region. As of the end of 1970, approximately 15,700 miles of transmission circuits rated

230 kilovolts or higher were in service. This included approximately 2,200 miles of circuits rated 500 kilovolts or higher. Interconnections exist with the Rocky Mountain Power Pool, the Pacific Southwest, and New Mexico areas. The interconnection of western regions was substantially enhanced when the large capacity, extra high voltage interties with the Pacific Southwest were completed. Two of these interties are of 500 kilovolt alternating current and a third is an 800 kilovolt direct current line.

The transmission circuits and interconnections not only deliver power from generators to load centers, but also enhance the firm capability of each individual utility system and reduce the total requirements for generator reserves. The interregional lines permit sales of surplus secondary energy and peaking capacity to the Southwest. Exchange of capacity between the two regions to take advantage of seasonal differences in load provides substantial advantages to both regions. The exchange of Columbia-North Pacific capacity for Pacific Southwest energy is effecting savings in capital cost for the Southwest utilities and increasing the firm power available in this region. Offpeak steam energy from the Southwest enables the Columbia-North Pacific to firm up some 330,000 kilowatts of secondary energy. The interregional lines also facilitated consummation of the 1964 Columbia River Treaty with Canada by making possible the sale of Canada's share of treaty power to the Southwest.

Needs

Regional annual energy requirements are projected to increase from 102.6 million megawatt-hours in 1970, to 1,286 million megawatt-hours by 2020 (table 39). This estimate is based on a steady expansion of per capita use and population estimates by OBERS for 10 subregions and special estimates for Type 2 studies of the Willamette and Puget Sound Subregions.

Table 39 - Future Electric Power Requirements
Columbia-North Pacific Region

Requirement	1970	1980	2000	2020
Peak Capacity (1,000 mw)	21.5	33.8	102.3	256.9
Energy (1,000 mwh)	102,641	193,200	512,000	1,286,000

SUMMARY OF REGIONAL NEEDS

SUMMARY OF REGIONAL NEEDS

The water and related resource needs which were discussed in preceding chapters are summarized in table 40. This summary gives the estimated current development, gross needs for 1980, 2000, and 2020, and reduces the gross needs for the current development to derive the residual needs.

Electric power exhibits the highest rate of projected growth, rising nearly 12 times the current development to almost 257,000 MW of capacity and 1,286,000 million kilowatt hours of energy by 2020. A comparison of the projected growth of electric power with the projected population growth of 2.4 times the current level over the same period indicates the magnitude of anticipated electric power demands.

The rate of growth in needs for recreation development and pleasure boating also increases much faster than population, reaching more than 5 times the current level by 2020. This reflects not only population, income, mobility, and leisure time, but to some extent, the attractiveness of the region's natural environment. The needs for sport fishing and hunting follow closely the forecast growth of population.

Agriculture plays a dominant role because of the tremendous size of its water and related land needs. While projections of crop production by 2020 are about 2.4 times the current rate of production, irrigated land is forecast to increase by 6 million acres from the current 7.5 million acres reaching a total of 13.5 million acres by 2020. The need for management of the watersheds exhibits sizable growth patterns, particularly in bank stabilization and in channel alterations. These measures are elements which have been deferred in the past and the longer they are held off, the more massive the need becomes. Flood damages represent a large monetary loss, both on major streams and on tributaries. This demonstrates a requirement for management and regulation of the flood plains and for structural measures where justified.

Navigation needs, expressed in terms of commerce, picture the growing importance of the region in the markets of the world and the increased use of low cost water transport for internal movements of commodities. The needs for municipal and industrial water reflect the increasing water demands of urban living and the projected growth of industry adjusted to reflect recycling. The lower rate of raw waste and treated discharges indicates recycling and higher levels of treatment.

In perspective, these needs represent a cross section of the future of the region. The development of a framework plan to meet these needs will provide a usable guide for planning this future.

Table 40 - Needs Summary, Columbia-North Pacific Region

Purpose or Function	Units	Current (1970) Development	Projected Gross Needs 1980	Projected Gross Needs 2000	Projected Gross Needs 2020	Residual Needs 1980	Residual Needs 2000	Residual Needs 2020
Water Development and Control								
Electric Power								
Capacity (Peak) 1/	mw	21,526	33,800	102,300	256,900	12,274	80,774	235,374
Energy 1/	mil kwh	102,641	193,200	512,000	1,286,000	90,559	409,359	1,183,359
Navigation								
Commerce	1,000 tons	97,580	144,500	229,100	390,300	46,920	131,520	292,720
Water Quality Control								
Raw Waste Production 2/	1,000 p.	44,520	54,791	73,613	95,382	10,271	29,093	50,862
Waste Removal 2/	1,000 p.e.	24,559	43,593	60,527	79,001	19,034	35,968	54,442
Municipal and Industrial Water								
Supply	mgd	3,129	4,181	6,153	8,624	1,052	3,024	5,495
Municipal	mgd	(1,008)	(1,433)	(2,198)	(3,414)	(425)	(1,190)	(2,406)
Industrial	mgd	(1,911)	(2,499)	(3,641)	(4,823)	(588)	(1,730)	(2,912)
Rural-Domestic	mgd	(210)	(249)	(314)	(387)	(39)	(104)	(177)
Flood Damages								
Major Streams 3/	Ann. $1,000	26,546	-	-	-	38,333	66,709	123,964
Bank Erosion 3/	Ann. $1,000	7,453	-	-	-	8,186	9,594	11,292
Area Flooded 3/	1,000 ac	1,617	-	-	-	1,617	1,617	1,617
Irrigation								
Total Irrigated Area	1,000 ac	7,503	10,098	11,396	13,503	2,595	3,893	6,000
Water Short Area	1,000 ac	(1,970)	-	-	-	(1,970)	(1,970)	(1,970)
Water Supply	1,000 ac-ft	33,739	45,814	50,119	57,308	12,075	16,380	23,569
Water and Related Land Programs								
Fish and Wildlife								
Commercial Fishery	1,000 lbs	183,441	269,753	357,230	466,671	86,312	173,789	283,230
Sport Fishing	1,000 days	21,346	32,223	45,418	64,146	10,877	24,072	42,800
Resident Species	1,000 days	(14,527)	(21,189)	(29,571)	(41,487)	(6,662)	(15,044)	(26,960)
Anadromous, Marine, Shell	1,000 days	(6,819)	(11,034)	(15,847)	(22,659)	(4,215)	(9,028)	(15,840)
Hunting	1,000 days	10,504	13,521	18,461	23,622	3,017	7,957	13,118
Water Related Recreation								
Development	1,000 rec days	89,300	139,200	271,500	511,200	49,900	182,200	421,900
Reg. Surface Water Use 4/	acres	367,900	536,800	1,016,400	1,870,300	168,900	648,500	1,502,400
Land Area (Rec. Facility Development)	acres	30,700	76,200	130,000	239,600	45,500	99,300	208,900
Pleasure Craft	no. (1,000s)	423	619	1,182	2,210	196	759	1,787
Watershed Management								
Flood Damages--Minor Streams 3/	Ann. $1,000	35,803	-	-	-	46,525	62,089	83,992
Area Flooded 3/	1,000 ac	2,308	-	-	-	2,308	2,308	2,308
Erosion and Sediment Control	1,000 ac	15,282	23,187	35,482	47,351	7,905	20,200	32,069
Drainage	1,000 ac	905	1,285	1,764	2,252	380	859	1,347
Beach Erosion Control	miles	-	-	-	-	227	227	227
Bank Stabilization	miles	2,256	6,799	13,832	19,372	4,543	11,576	17,116
Levees and Floodwalls	miles	964	2,067	3,633	5,253	1,103	2,669	4,289
Channel Improvement	miles	5,290	13,723	24,345	33,815	8,433	19,055	28,525
Protection and Management 5/	1,000 ac	120,255	130,277	132,131	132,910	95,744	97,596	98,614
Water Conservation	1,000 ac	7,139	9,827	11,079	13,142	2,688	3,940	6,003
Water Yield Improvement	1,000 ac	0	117	349	612	117	349	612
Related Land Production								
Croplands	1,000 tons	29,722	41,271	54,252	71,606	11,549	24,530	41,884
Irrigation	1,000 tons	(21,140)	(32,010)	(45,135)	(63,537)	(10,870)	(23,995)	(42,397)
Dryland	1,000 tons	(8,582)	(9,261)	(9,117)	(8,069)	(679)	(535)	(-513)
Forest Wood Fiber	mil cu ft	4,227	4,597	5,179	5,298	370	952	1,071
Range Grazing Capacity	1,000 aum	7,269	8,454	10,396	11,824	1,185	3,127	4,555

1/ 1970 development and loads assuming critical water year.
2/ Includes municipal, industrial, and recreation use.
3/ Needs over 1970 level of flood prevention.
4/ Needs are a function of recreation day requirements.
5/ Includes recurrent programs that will require acceleration with implementation of a plan. Residual needs cannot be determined by subtracting current development from gross needs as many of these practices are applied annually on the same areas.

FRAMEWORK PLANS
AND PROGRAMS

FRAMEWORK PLANS AND PROGRAMS

This section describes the regional framework plans and programs that were evolved within the concepts embraced by the objectives, criteria, and methodology set forth at the beginning of this appendix, and the resources, projected needs, and opportunities developed in the functional appendixes. This planning was accomplished for 12 subregions and the results consolidated into the following broad hydrologic-political areas (figure 1):

Area A - Upper Columbia River Area,
Subregions 1, 2, and 3.
Area B - Snake River Area, Subregions 4, 5, and 6.

Area C - Middle Columbia River, Oregon Closed Basins, and
Oregon Coastal Area, Subregions 7, 9, 10S, and 12.
Area D - Lower Columbia and Washington Coastal Area,
Subregions 8, 10N, and 11.

Within each of these areas, plans were formulated for each of the river basins or subareas by interagency task forces under the chairmanship of individual states.

The planning process began with an inventory of existing water, land, and mineral resources to evaluate the basic resources. Functional needs were derived from the economic base and projections studies and the most effective and least costly solutions were sought for each need. Alternative solutions were considered in response to the other study objectives of regional development and environmental quality. Single-purpose solutions were compared within each time frame for potential conflicts, and adjustments were made or alternatives proposed when conflicts could not be resolved. Multiple-purpose solutions were recommended when these appeared to be more responsible to study objectives.

While the best alternative could be selected for portions of the areas, there are basins or subareas where the complexity of problems and wide array of alternatives, coupled with lack of available data, precluded the selection of the best framework plans and programs. In those instances, interdisciplinary studies were included in the framework plan.

The following text begins with a discussion of the regional planning considerations to provide a background and a basis for planning of the four individual areas. Planning considerations are described for each area by river basin or subareas. Needs and

problems, opportunities and alternatives to meet the needs are discussed, and some generalities concerning the framework programs by time frame are provided. Functional elements of the area framework plans and programs then are derived.

As the studies are based on available data, the depth of the study varies considerably between river basins, subregions, and areas in coverage of individual water and land resource functions. Also the policies and the stage of planning of the individual states have a bearing on the presentation. For example, the Idaho Water Resource Board has determined that a full water resource plan not be formulated in this study at this time, whereas the advanced stage of planning in the State of Oregon permits a more detailed presentation of a framework plan. Accordingly, in some river basins or subareas, projects and locations of developments and programs are detailed, while in others the treatment is general and broad in context.

REGIONAL PLANNING CONSIDERATIONS

Regional planning considerations are those elements of water and related land resources which are regionwide in nature and require consideration in the planning of the four individual areas. The following discussion deals primarily with Columbia River Basin. However, those elements having impacts beyond the confines of the Columbia River drainage are included where their effects are significant. This is particularly true of electric power where a coordinated system serves most of the region and some outside areas through a high voltage transmission network by interutility contracts, coordination and pooling agreements, and transmission interconnections.

Electric Power

Up to the present time, power needs have been met almost exclusively with hydroelectric generation. Although conventional undeveloped hydroelectric sites have been identified which could add 4,696 megawatts of average energy and increase the peaking capability of the system by 18,295 megawatts, the projected loads are such that this would fall far short of meeting requirements by year 2020. Consequently, thermal generation will be required to meet much of the new demand. It is anticipated that thermal capacity will ultimately carry virtually all of the base load while hydro will be used primarily to meet peak loads.

To present as wide a range of hydro-thermal system combinations as possible, load resource analyses were made in Appendix XV, Electric Power, for a maximum and a minimum

hydro system. The maximum hydro system presumed continued major storage development and included all identified potential conventional hydro projects not located on an established wild river. The minimum hydro system includes only hydro projects which are now existing or under construction. Both plans include all reasonably firm additions to hydroelectric projects existing and under construction, i.e., all authorized additions to Federal projects and all future units for which space is provided at licensed non-Federal projects. The framework plan, which would be evolved from consideration of all potential projects in each subregion, would nearly approximate the minimum hydro system. For this reason, the maximum cooling water requirements associated with minimum hydro system would be included.

Figures 4 and 5 show the projections developed for this study and the role of the two systems in meeting these demands.

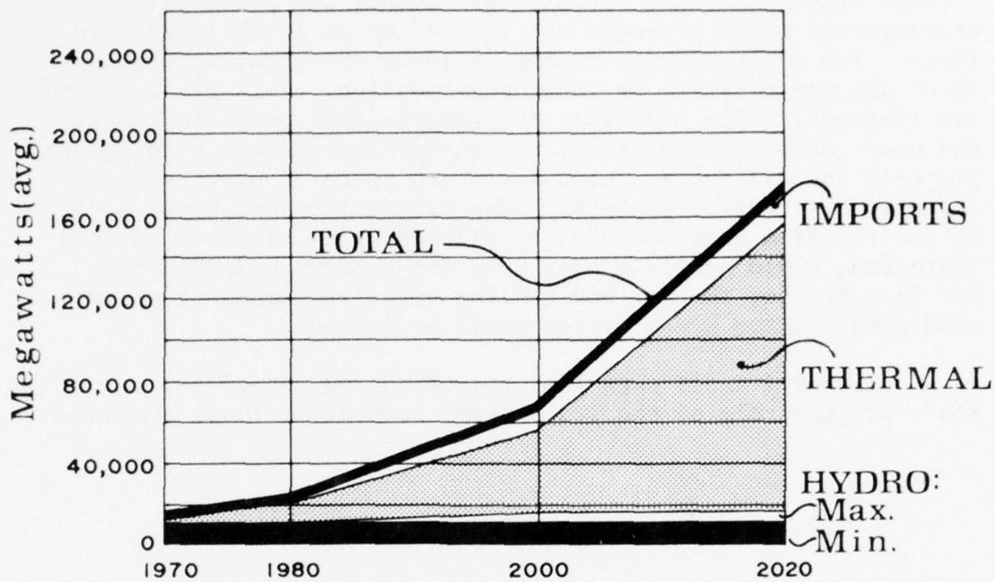


FIGURE 4. Power Projections--Energy

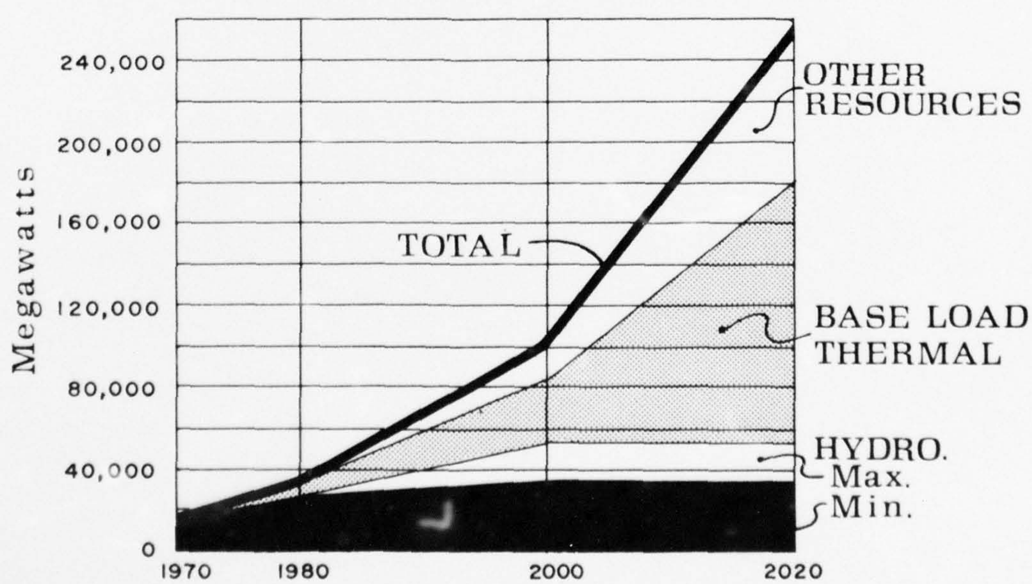


FIGURE 5. Power Projections--Capacity

Flood Control

The Puget Sound and coastal areas experience frequent floods which often occur in highly developed but independent river systems. The few flood control reservoirs are mostly located in the Puget Sound area, however, this subregion has only 106,000 acre-feet of allocated primary and 226,000 acre-feet of joint use flood control storage. Problems are especially acute in the Nooksack, Skagit, Snohomish, and Green-Duwamish River Basins. In the coastal drainage the most significant problems are along the larger streams such as the Rogue, Umpqua, Coquille, and Chehalis Rivers.

The Willamette River, which flows through the highly developed Willamette Valley, has caused millions of dollars of damages. Multiple-purpose reservoirs constructed in this drainage provide a system with 1,810,000 acre-feet flood control storage. The existing reservoirs prevented over $500 million damages in the December 1964 flood alone, including over $40 million damages prevented along the lower Columbia River below Vancouver. This illustrates the importance of the Willamette flood control operation to both the Willamette Valley and the lower Columbia River areas.

The plans and programs in this study include storage on several of the Columbia River tributaries that presently add to flood discharges. However, these are not major tributaries and their peaks are of much shorter duration than the extended flows of the Columbia under controlled releases. Thus the storage will primarily benefit the respective tributary areas with limited impact on the main stem of the Columbia River. The primary exception is the improvement of the outlet of Flathead Lake, which would add over 600,000 acre-feet to the system operation.

Further flood control of the Columbia River system can be realized by controlling the high flows from the Clearwater and Salmon Rivers. Portions of both rivers are designated wild rivers and other portions are under study for possible additions to the system. For these and other reasons, this study does not recommend major storage on either of these rivers.

A major improvement in flood control will result from the 1964 Columbia River Treaty with Canada which will provide 20.4 million acre-feet of storage in Canada for flood control of which nearly 12 million acre-feet would be on-call storage and available only if planned for prior to February 1st. In addition, the treaty provides for nearly 5 million acre-feet of storage in Libby Reservoir on the Kootenai River by 1973. When all these projects are completed, more than 43.5 million acre-feet (Snake River included) of joint use storage space will be available on a forecast basis for control of the Columbia River spring floods.

With this storage, the 1894 flood would be controlled to 668,000 cfs at The Dalles and the flood state at Vancouver, Washington, would be reduced from an uncontrolled 34.4 feet to 22.4 feet, eliminating all major damages. However, with this flood, low-lying lands would be inundated for more than 40 days as overbank flow begins at 16 feet on the Vancouver gage.

Navigation Systems

Coastal Ports

In the Puget Sound area, little channel improvement has been required because of natural deep water in the bays and inlets used for port development. Early channel work was primarily clearing and snagging with minor dredging at the mouths of Snohomish, Skagit, and Stillaguamish Rivers. Lake Washington Ship Canal, constructed in 1916, connects Lake Washington and Lake Union to deep water in Puget Sound.

The Coos and Yaquina Bays, Coquille and Siuslaw Rivers, and Grays Harbor are some of the locations that were improved by entrance jetty systems to serve the needs of navigation. Shipping from these and other coastal points increased as products from logging, fishing, and agriculture developed.

Inland System

Only on the Columbia River and its tributaries is navigation developed and operated as a regional interstate system. The locks and channels on the Columbia and Snake Rivers provide a waterway system which, when completed in 1973, will extend from the Pacific Ocean to Lewiston, Idaho, on the Snake River, 465 miles from the sea. The dams on this waterway are described previously under "Navigation."

The Willamette River above Portland has an improved open river shallow draft channel extending 132 miles to Corvallis with four locks at Willamette Falls. The channel is used primarily for towing log rafts and, in its lower reaches, for barge movement of sand and gravel.

Annual commerce on the Columbia-Snake system is forecast to increase from 11.5 million tons in 1968 to 20.1 million tons in 2020. Willamette River commerce is projected to increase from 5.3 million tons in 1968 to 13.2 million tons in 2020.

A growing recreational boat traffic is using these inland waterways as they are extended upstream. In addition, the individual reservoirs are used extensively for recreational boating.

Improvements required to accommodate increased navigation include: a 125-mile extension of the channel in the upper Columbia River, including three new locks at existing dams; river navigation in the lower Snake River, including completion of a dam and lock under construction; improvement of the open river channel in the Willamette River for 96 miles above the falls at Oregon City; and reconstruction of the locks at Oregon City and at Bonneville Dam.

Irrigation

Regionwide, the significance of irrigation is related to the amount of water withdrawn from the Columbia, Snake, Yakima, and other rivers. In some reaches these diversions are in conflict with instream water uses for fish, water quality, recreation, and power generation.

About 6.5 million acres of irrigated lands, or about 88 percent of the total of 7.5 million acres in the region, are adjacent to the Columbia River and its tributaries. Most of the 40 million acres of irrigable lands are also in similar locations. The withdrawal of water for irrigation, now and in the future, can have a major impact on the operation of the river for other purposes. At some locations, such as the Upper Snake River, decisions on how to meet the future instream needs will control the extent of irrigation. Thus, irrigation withdrawals can be a significant factor in the operation of the Columbia River system, particularly during critical low-water years.

The projection of future acreage under irrigation is that amount of land which would have to be irrigated if the levels of production of food and fiber, projected by OBERS in 1968, are to be attained. This overall estimate was disaggregated to subregions on the basis of availability and proximity of irrigable land and water, historical trends, and other known facts.

Where conflicts developed between use of water and land, alternatives were developed and analyzed. The plan meeting the needs with least impact on the environment was used. If water was not available, irrigated land was shifted to other locations within the state.

Anadromous Fish in the Columbia River Basin

Some of the major problems relate to the Columbia River system which has historically been one of the world's largest producers of anadromous fish. In 1965, the commercial catch was about 45 million pounds and sportsmen spent about 5 million days in pursuit of these fish. A major factor limiting anadromous fish production is the dams on the Columbia River and its tributaries. These impoundments have inundated large areas of spawning habitat and, in many cases, blocked upstream migrations and inhibited successful downstream migrations of juveniles. The maintenance and enhancement of anadromous fish runs is of regionwide concern, and a system of 76 hatcheries and fish passage facilities are operated to preserve this fishery.

In recent years, a new and previously unforeseen problem has developed. Large numbers of fish have been killed by air embolism which is similar to the bends suffered by human divers. The water becomes supersaturated with nitrogen from entrained air when passed over spillways. It affects both juveniles and adults. The problem is widespread throughout the Columbia below Chief Joseph Dam and along the lower Snake River. Extensive studies are underway in an attempt to determine corrective measures.

The Columbia River Fishery Development Program was initiated in 1948 to preserve, protect, and enhance the anadromous fish runs. Participating are the fish and game conservation agencies of Idaho, Oregon, and Washington, the Bureau of Sports Fisheries and Wildlife, and the National Marine Fisheries Service. The major portion of the funds for the program has gone into the construction and operation of hatcheries providing fish passage on tributaries and screening irrigation diversions.

The demand for sports and commercial fisheries, either existing or projected, exceeds the foreseeable supply. The value of the resource from an economic or recreational standpoint warrants preservation and enhancement. A continued and expanded Columbia River fishery development program is required to preserve and improve habitat, to protect the migrating fish, and to augment supply. Such a program needs to treat the resource as a regional system, where each fragment of development or protection, either State or Federal, is planned in relation to the whole program. Consideration must be given to the fishing rights of the Indian tribes which were parties to treaties executed by Governor Isaac Stevens when the territory was settled in the mid-1800's.

Compatibility of Storage

Storage in the region, including the portion of the Columbia River Basin in Canada, has been developed for the production of hydroelectric power, reduction of flood peaks, irrigation of 7 million acres of land, recreation, fish, municipal and industrial water supply, and other uses. The total active storage in the nearly 200 reservoirs having a capacity greater than 5,000 acre-feet exceeds 40 million acre-feet. In addition, Libby and Dworshak projects, which are nearing completion, will add about 7 million acre-feet and the Mica project in Canada a similar amount. Accordingly, the compatibility of storage in serving a wide range of water resource purposes is an important element to be considered in planning.

The Columbia-North Pacific Region is divided into two areas of distinctly different hydrologic character, one lying west of and the other east of the Cascade Range. West of the Cascades, streams are relatively short and drain into the Pacific Ocean, Puget Sound, or the lower Columbia River. Precipitation from the predominant winter storms is generally in the form of rain, and the rapid runoff cannot be reliably forecast more than a few days in advance. East of the Cascades, the Columbia River drains an area in excess of a quarter million square miles, where snowmelt runoff is the dominant factor in the annual streamflow pattern.

Reservoirs East of the Cascades

The bulk of the storage capacity is east of the Cascades in the Columbia River Basin, where the streamflow regime is established largely by the snowmelt runoff pattern. Unregulated flows are generally low in the winter and early spring, when most of the precipitation accumulates as snowpack, high in late spring and early summer as the snowpack melts, and low again in the late summer and fall.

The storage regulation season of the large projects comprising the coordinated Columbia River system begins with the reservoirs full (or nearly full) at the end of the snowmelt season. Draft of storage begins when natural streamflows recede to the extent that the system hydroelectric projects cannot generate enough power to meet their share of the regional load. These storage releases generally begin in late August and reach a maximum in January, when the power loads are greatest. They continue until late spring when loads fall off and streamflow picks up to the extent that power demand can be met from unregulated flows. At this time, the reservoirs are at their lowest annual levels, and they begin to refill. Filling is

usually completed by mid-July. Flood control, an important element in these plans, is generally complementary to power regulation. The prime objective of flood control on these streams is to keep the peak flows resulting from the spring snowmelt runoff below damaging stages. In many years drafting for power purposes evacuates enough storage to provide adequate flood control space, but in years of high runoff additional drafting may be required. Through the use of advanced forecasting techniques, evacuation and refill are scheduled in such a manner as to maximize flood stage reduction while insuring refill for next winter's power production.

The reduction in flood flows early in the summer and the augmentation of flows in late summer and fall benefit river recreation. During the summer, the streamflows are affected very little by regulation. As the reservoirs are usually filled early in the summer and large scale drafting does not begin until fall, the levels of the storage reservoirs are usually near optimum for recreational use during most of the summer season. However, at several reservoirs there is some conflict with early season recreation, especially in years when the snowmelt occurs later than usual. In unusually dry years, drafting may be required early in the recreation season and some reservoirs may not completely fill. However, with the completion of Dworshak, Libby, and Mica, there will be a greater degree of flexibility in the Columbia River system, and in some cases it may be possible to adjust system regulation to favor certain reservoirs where at-site recreation is particularly important.

Navigation on the Columbia and Snake Rivers is assisted by the control of floodflows in the spring and early summer.

Maintaining higher than natural flows in the Columbia and interior streams during fall and winter improves water quality. After completion of the reservoirs under construction, reduction in peak flows during the snowmelt season will also reduce the amount of spill required at downstream projects, which in turn will reduce nitrogen entrainment. In the case of municipal and industrial water supply, although such water use is small compared to the flow, improvement of the quantity and quality of streamflows during the low-flow seasons will provide some benefit.

The impact of seasonal regulation on fish and wildlife is very complex, in some ways beneficial, in other ways adverse. For example, reduction of the damaging high snowmelt floodflows is beneficial, but storage during years of low runoff can reduce flows to the point where downstream migration of fingerlings might be hindered. Augmenting streamflows during the low-flow

periods generally improves conditions for fish life, but the temperature of the reservoir releases sometimes causes problems for some species. Here again, with the inherent flexibility of the large reservoir system, it is often possible to favor some streams and some projects where critical fish and wildlife problems exist. In addition, multilevel outlets are being installed at some projects to provide better temperature control.

In addition to the reservoirs of the coordinated Columbia River system, there are over 100 reservoirs in the region with capacities greater than 5,000 acre-feet that include irrigation as the major function. Because most of these reservoirs were constructed primarily for irrigation, their operation pattern is irrigation oriented. However, this operational pattern is also often compatible with other storage operations, particularly flood control and augmentation of seasonal low flows. Irrigation water is stored whenever surpluses are available and most filling takes place in the spring snowmelt season with some during excessive winter runoff. This assists in reducing peak flows and also reduces bank erosion, sediment loads, and improves water quality. Subsequent releases in mid and late summer usually increase the normal seasonal minimum flows through instream releases and return flows. However, there are some instances when winter storage reduces downstream flows below levels compatible with instream needs for fish life. The most obvious conflict in irrigation storage arises with reservoir recreation as it relates to drawdown. Irrigation releases must be made in summer and early fall, coincident with the heaviest water-based recreation season.

Reservoirs West of the Cascades

Streamflow patterns in the area west of the Cascades are different, with direct precipitation runoff accounting for base flows and sporadic storm-caused high flows in the late fall, winter, and early spring. Flow in most streams in the area tapers off with reduced precipitation in late spring and is generally very low through summer and early fall. A few streams which drain the high Cascade and Olympic Mountains also have high flows in late spring from snowmelt runoff although flooding from this cause is less severe than from winter precipitation. Most of these latter streams also have good summer and fall base flows.

Most of the major storage projects in this area fall into two categories: hydroelectric projects owned and operated by the utilities and subject to regulation by the Federal Power Commission, and multiple-purpose Federal projects with major emphasis on flood control.

Releases from the power reservoirs are made as needed to meet required power demands, with the largest releases being made during the winter months. Because these reservoirs are usually partially drawn down at the time the winter storms take place, they do provide some incidental flood control storage. In addition, several power reservoirs are operated to provide significant control over spring snowmelt runoff. Because these reservoirs are normally kept near full during the summer season, they are compatible with at-site recreation. Most of these reservoirs are located on streams which do not have serious low-flow problems, but they do provide some incidental augmentation during the more critical periods.

The Federal multiple-purpose reservoirs on the Willamette, Rogue, Green, and White Rivers, are operated for flood control during the winter season and conservation storage in the summer and fall. During the winter, these reservoirs are maintained at their minimum pool elevations except when regulating storm runoff in the interest of flood control.

Filling commences in early spring and is normally complete by late May or early June. During the summer, base flows usually drop markedly due to prevailing dry weather, and in most years reservoir releases are required for flow augmentation. These releases serve navigation, irrigation, water quality, fish and wildlife, municipal and industrial water supply, and stream-based recreation. Here again, releases are utilized for power production at those projects with hydroelectric facilities. This aspect becomes particularly important in late fall when power demands begin to rise. Conservation releases are sometimes required early in the summer, and this has an adverse effect on recreation on the reservoirs. In the Willamette Basin, this problem is partially relieved by making the earlier withdrawals from those reservoirs having the least at-site recreation.

In summary, seasonal regulation of the region's reservoirs benefits many more river uses than were originally contemplated and few adverse impacts result. However, some important benefits, particularly at the irrigation reservoirs, are foregone because the project authorizations do not include functions such as recreation, flood control, fish environment, water quality, etc. Accordingly, studies are needed, both of individual projects and of systems of projects, to determine if operating plans should be modified to give greater emphasis to certain functions now being neglected, to incorporate additional functions where appropriate, and to consider trade-offs among projects in systems.

Natural Environment

The needs for preservation and enhancement of the natural environment for the region have been covered in the preceding text. Some of major items mentioned were the need for establishing minimum flows for environmental values, landscape management and control, identifying and planning for preservation and public use of scenic, historical, unique, and fish and wildlife areas; and the determination of proper level of human use of terrain having a fragile ecological balance such as high alpine, desert, and dune areas.

In contrast to the several independent drainage systems in the region, the environment of the Columbia River and its shorelands relates directly to operation of the system of dams and reservoirs and to the diversions and depletion of the river flows for irrigation and other purposes. Accordingly, the preservation, enhancement, and public enjoyment of the natural environment should be an integral element in the management of the existing and future river system. To be a part of such a system, the natural environment and its accompanying recreation use should be considered as a whole instead of a fragmented series of problems, possibilities, and development.

There is a need for coordinated water and related land use plans and programs which integrate all existing planning and developments into a comprehensive plan to chart the future use of the river for industrial, residential, commercial, and recreational uses and for preservation of the natural environment. This planning could lead to the ultimate development of a scenic parkway along the river extending from the Pacific Ocean to the Canadian boundary and, with the cooperation of Canada, to the headwaters of the Columbia River system. The Columbia River should be viewed from its geological standpoint, its historic and ecological aspects, its scenic and fish and wildlife assets, as well as water and related land activities; and a plan should be developed for implementation jointly by private, State, and Federal efforts.

LOCATION MAP

AREA A

AREA A
UPPER COLUMBIA RIVER, SUBREGIONS 1, 2, and 3

Description

The upper Columbia River Area comprises the watershed of the Columbia River in the United States above its confluence with the Snake River. It covers 64,875 square miles lying between the Cascade Range on the west and the Rocky Mountains on the east in the States of Washington, Idaho, and Montana. In between are several other mountain ranges and the Columbia Plateau, a relatively flat tableland that slopes gently southwestward (figure 6).

Major tributaries of the Columbia River in this area are the Kootenai, Clark Fork-Pend Oreille, Spokane, Okanogan, Wenatchee, and Yakima Rivers. Minor tributaries include Crab Creek and the Colville, Kettle, Methow, and Entiat Rivers and other lesser streams. There are others such as the Flathead and Bitterroot Rivers that are tributary to major streams that contribute large amounts of water.

The climate reflects maritime Pacific air masses, modified by passage across the Cascade Range. Temperatures during the winter are typically 15° to 30°F. with extremes as low as -50°F. Summer temperatures range from about 50° to 90°F. and occasionally reach 100°F. or more. Annual precipitation varies from 7 inches in the Columbia Plateau to 60 inches at the Continental Divide, and more than 100 inches in the Cascades.

Nearly two-thirds of the area is forested, mainly with fir and pine, the only large nonforested portion being the Columbia Plateau. About one-fifth of the land is open range, mostly in the Columbia Plateau and the foothills bordering the Columbia River and its tributaries. The greater part of the cropland is in the Columbia Basin and the Yakima and Flathead Valleys. Large quantities of fruit are produced in the Yakima, Wenatchee, Okanogan, and Flathead Lake areas. Potatoes and sugar beets are raised in large amounts in the Columbia Basin and the Yakima Valley. However, most of the cropland produces forage crops and grains under both irrigated and dryland farming. Cattle are raised throughout the area. Wildlife and fish are abundant and provide both sport and commercial values.

The population in 1970 was 1,008,800. The largest city, Spokane, at about the midpoint of the area, has a population of 283,000, including environs. Major cities to the west are Wenatchee, Ellensburg, Yakima, and Pasco-Kennewick-Richland. East of Spokane, the larger communities are Coeur d'Alene, Missoula, Butte, and Anaconda.

Industries include food processing, lumber and wood products, aluminum refining, mining and refining of copper, lead, and zinc, and production of cement and vermiculite. Slightly more than a quarter of the employed population is engaged in agriculture, forestry, mining, and manufacturing. Manufacturing employment is chiefly in food processing, primary metals, and the forest products industry. Recreation as an industry consists chiefly in supplying the needs of visitors who come to enjoy the scenic natural features of the area and state and Federal parks.

The area is generally well served by highways, railroads, and airlines. The one important mode of transportation that is lacking is water. There is no through navigation on this portion of the Columbia River system above the Pasco-Kennewick-Richland area. Limited commercial navigation, mostly log tows and ferries, utilize some of the large lakes and reservoirs.

The two most highly developed aspects of the water and related land resources are hydroelectric power and irrigation. By 1970, the area had a generating capacity, installed or under construction, of about 11,000 megawatts, mostly in seven olumbia River plants. Irrigation of approximately 1.8 million acres accounts for about 97 percent of the total consumptive use of water.

Water and land resource needs of the area are summarized in table 41. Areas to satisfy the recreation days and maintain the natural environment are shown in terms of acres. Fish and wildlife needs are expressed in terms of use and catch.

Flood control needs are expressed in dollars of projected average annual damages, and waste treatment needs are expressed in population equivalents. Much of the land area is highly erodible and intensive land treatment measures must be employed to permit its proper utilization. This is illustrated by the extensive acreages requiring various practices shown under watershed management. The irrigated acreage will need to more than double by 2020, and in some basins problems of obtaining sufficient water at proper times and locations must be resolved.

Commercial through navigation to Wenatchee could be a new use of the Columbia River. The projected 7.6 million tons of annual waterborne commerce require navigation improvements including the installation of locks in three existing dams. Without the improvements, commerce would move by other modes.

The water rights of the Flathead, Coeur d'Alene, Kalispell, Kootenai, Spokane, Colville, and Yakima Indian Reservations, and the Chelan allotments must be considered in Columbia River planning.

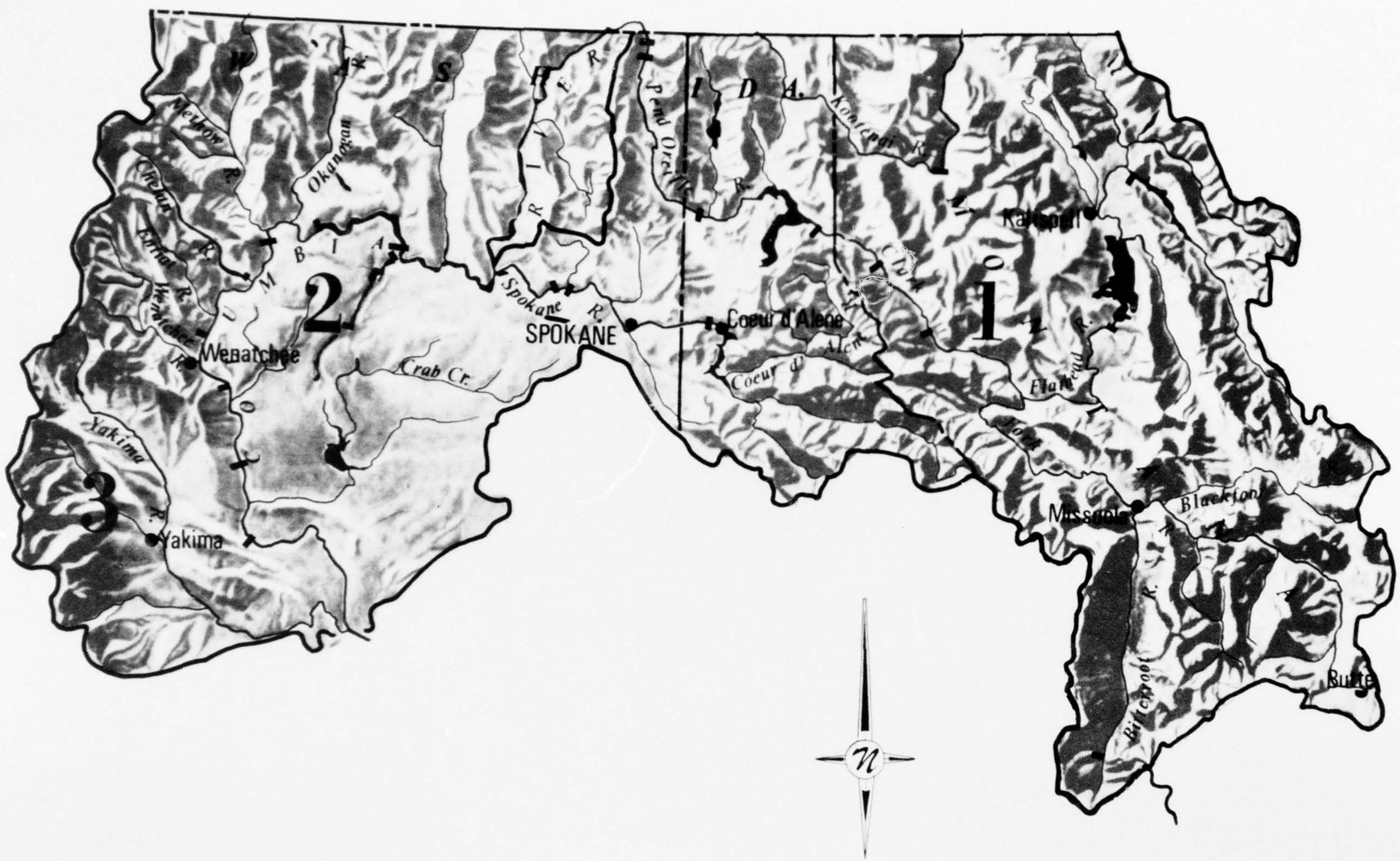


FIGURE 6. Plan Formulation Area A

Table 41 - Needs Summary, Area A, Columbia-North Pacific Region

Purpose or Function	Units	Current (1970) Development	Projected Gross Needs			Residual Needs		
			1980	2000	2020	1980	2000	2020
Water Development and Control								
Electric Power								
Capacity (Peak)	mw			Projected on a Regional Basis Only				
Energy	*mil. kwh*			" " " " " "				
Navigation								
Commerce	1,000 tons	170	4,300	6,000	7,800	4,130	5,830	7,630
Water Quality Control								
Raw Waste Production 1/	1,000 p.e.	4,461	6,550	9,882	14,444	2,089	5,421	9,983
Waste Removal 1/	1,000 p.e.	3 927	5,567	8,894	13,000	1,640	4,967	9,073
Municipal and Industrial Water								
Supply	mgd	507	624	841	1,106	117	334	599
Municipal	mgd	(209)	(261)	(386)	(546)	(52)	(177)	(337)
Industrial	mgd	(236)	(291)	(366)	(451)	(55)	(130)	(215)
Rural-domestic		(62)	(72)	(89)	(109)	(10)	(27)	(47)
Flood Damages								
Major Streams 2/	Ann. $1,000	3,510	-	-	-	5,468	10,422	20,960
Bank Erosion 2/	Ann. $1,000	668	-	-	-	886	1,119	1,583
Area Flooded 2/	1,000 acres	200	-	-	-	200	200	200
Irrigation								
Total Irrigated Area	1,000 acres	1,843	2,690	3,010	3,850	847	1,167	2,007
Water Short Area	1,000 acres	(338)	-	-	-	(338)	(338)	(338)
Water Supply	1,000 ac-ft	8,203	11,892	13,313	16,182	3,689	5,112	7,979
Water and Related Land Programs								
Fish and Wildlife								
Commercial Fishery	1,000 lbs.	0	0	0	0	0	0	0
Sport Fishing	1,000 days	5,037	7,024	9,314	12,130	1,987	4,277	7,093
Resident Species	1,000 days	(4,967)	(6,904)	(9,154)	(11,920)	(1,937)	(4,187)	(6,953)
Anadromous, Marine, Shell	1,000 days	(70)	(120)	(160)	(210)	(50)	(90)	(140)
Hunting	1,000 days	2,813	3,465	4,567	5,918	652	1,754	3,105
Water Related Recreation								
Development	1,000 rec. days	15,900	23,600	44,300	81,300	7,700	28,400	65,400
Required Surface Water Use 3/	acres	67,300	80,200	148,800	274,200	12,900	81,500	206,900
Land Area (Rec. Facility Development)	acres	8,700	15,700	23,300	40,800	7,000	14,600	32,100
Pleasure Craft	no. 1,000s	72	83	155	284	11	83	212
Watershed Management								
Flood Damages--Minor Streams 2/	Ann. $1,000	5,217	-	-	-	6,358	7,509	8,714
Area Flooded 2/	1,000	387	-	-	-	387	387	387
Erosion and Sediment Control	1,000	3,652	5,137	7,977	10,171	1,485	4,325	6,519
Drainage	1,000	191	245	334	417	54	143	226
Beach Erosion Control	miles	-	-	-	-	0	0	0
Bank Stabilization	miles	608	2,147	3,966	5,296	1,539	3,358	4,688
Levees and Floodwalls	miles	74	228	376	493	154	302	419
Channel Improvement	miles	1,741	4,381	7,690	10,941	2,640	5,949	9,200
Protection and Management 4/	1,000	28,624	29,275	29,974	30,605	26,007	26,706	27,539
Water Conservation	1,000	1,662	2,611	2,926	3,738	949	1,264	2,076
Water Yield Improvement	1,000	0	52	147	244	52	147	244
Related Land Production								
Crop	1,000 tons	9,332	13,991	18,643	24,641	4,659	9,311	15,309
Irrigation	1,000 tons	(6,675)	(10,681)	(15,701)	(23,606)	(4,006)	(9,026)	(16,931)
Dryland	1,000 tons	(2,657)	(3,310)	(2,942)	(1,035)	(653)	(285)	(-1,622)
Forest Wood Fiber	mil. cu. ft.	632	703	791	818	71	159	186
Range Grazing Capacity	1,000 aum	1,031	1,101	1,435	1,585	70	404	554

1/ Includes municipal, industrial, and recreational use.
2/ Needs over 1970 level of flood prevention.
3/ Needs are a function of recreation-day requirements.
4/ Includes recurrent programs that will require acceleration with implementation of a plan. Residual needs cannot be determined by subtracting current development from gross needs as many of these practices are applied annually on the same areas.

Municipal, industrial, and rural-domestic water uses are projected to more than double. Treatment of wastes must be improved throughout the area, including both mine wastes and domestic and industrial wastes. This area presently generates tremendous amounts of hydroelectric power which is distributed regionwide. The western portion of the area will be favorable for location of large blocks of thermal electric power to serve population centers west of the Cascade Range.

Formulation of Area Plans and Programs

The upper Columbia River area has a wide range of opportunities to meet water and related land resource needs. Possible conflicts between objectives in some watersheds required the consideration of several major alternatives. These problems, the alternatives considered, and the plan, program, or study evolved, and the reasons for the selected course of action, are discussed. In some basins, additional studies would be required to develop the best plan or program. The Idaho Water Resources Board requested that the following statement be included: "A comprehensive plan has not evolved for the State of Idaho. The Idaho Water Resource Board, representing the State of Idaho in water resources planning functions, determined that a full comprehensive water resources plan for the state should not be fixed at this time. Many ongoing studies, such as Joint State Wild and Scenic Rivers Study, USDA Type IV Studies, the Western United States Reconnaissance Study, and the Columbia River and Tributary Study will provide additional information on resource use. Therefore, Idaho has elected to delay formulation of a plan, however, alternatives have been identified and, where possible, studies have been outlined that would resolve conflicts and/or would assist in the selection of a plan between competing uses."

Upper Clark Fork Subarea (Subregion 1)

The Upper Clark Fork Subarea comprises the drainage above the confluence of the Clark Fork and Blackfoot Rivers (figure 7). Minor flooding occurs along the Clark Fork and some tributaries. Recurrent flood damages are most prevalent at Deer Lodge and on the Blackfoot River near Lincoln. Watershed treatment problems result primarily from poor drainage, steep or irregular topography, and flooding and erosion. About 131,000 acres were irrigated in 1970, and there are 296,000 acres of potentially irrigable land which would be irrigated if adequate water supplies could be obtained. However, most of the potentially irrigable lands lie in the higher upland plateaus near headwater areas where water supplies are limited. About 73,000 acres are projected for

irrigation by 2020. In addition, supplemental water supplies for 18,000 acres of presently irrigated lands are needed. The 20-mile reach of the upper Clark Fork from Butte to Warm Springs, which includes Silver Bow Creek, is completely devoid of dissolved oxygen as a result of its use to transport mining, refining, and milling wastes to a treatment lagoon at Warm Springs. Anaconda Copper Company has recently begun to treat mill wastes, and discharge of untreated municipal effluents into the Clark Fork is expected to be curtailed in conformance with the state water quality standards by 1972. Coliform counts are, at times, high in Rattlesnake Creek, the municipal water supply source for Missoula. There is one small hydroelectric plant in the subarea, and a site remaining on the Blackfoot River which has potential of about 92 MW with 44 MW additional at a downstream reregulating site.

Environmental considerations in plan development included a number of streams with significant scenic, recreational, and sport fishing values which should be recognized; the need for additional facilities for camping, picnicking, and hiking; access to additional recreation, fishing, and hunting areas; and preservation of streams and historical areas. Establishment of minimum flows for fisheries and the acquisition of wildlife habitat are additional requirements.

A number of alternative solutions could be developed, some of which conflict with environmental considerations. Interbasin diversion of water from Rock Creek, Flint Creek, and other drainages could be developed for irrigating additional lands. However, depleting the water flows in Rock Creek could be harmful to the high valued fishing opportunities of this stream. Diversion from Flint Creek and other streams would be costly, provide limited development opportunities, and conflict with existing fishing opportunities. Numerous storage sites are available on the Blackfoot River and tributaries for irrigation, recreation, flow augmentation, and some minor hydropower development. However, the storage sites would inundate much of the potentially irrigable area.

With about 111,000 acre-feet of storage in small headwater reservoirs, water for 73,000 acres of new land and supplemental water for 18,000 acres now under irrigation could be supplied and sufficient water would be left in streams to meet fishery needs. Several small watershed projects were selected to aid in meeting water requirements. One storage alternative on the Little Blackfoot River for increased irrigation water use to the detriment of fisheries was rejected. Further ground-water studies should be made to obtain reliable estimates of the total water supply.

1970 to 1980 Program The general framework solutions for this period include construction of a levee to close the overflow channel on the Blackfoot River near Lincoln and diversion of Cottonwood Creek into Johnson Creek at Deer Lodge to prevent flooding. Flood plains in Powell, Granite, and Missoula counties would be studied and zoned to control development. Watershed projects would be carried out at five locations and forest land treatment at three locations. The development of 56,000 acres of new irrigated land and provision of supplemental water to 18,000 acres now under irrigation would meet irrigation requirements. The industrial waterway classification of the Clark Fork above Warm Springs and Silver Bow Creek would be rescinded and mine and mill waste treated to meet state water quality standards. Pending installation of these treatment facilities, existing dikes at the Warm Springs settling lagoon should be improved to prevent over-topping. Existing mine wastes in the upper Blackfoot Valley would be removed or neutralized. Scenic roads would be designated along Interstate 90 on the Clark Fork River and on U.S. 10A between Anaconda and Georgetown Lake. A study would be made on designation of the Blackfoot River and Rock Creek as recreation streams. Wetlands in the Blackfoot Valley should be acquired or leased for waterfowl nesting.

Resources are available to meet the needs of water supply, recreation, fish, and wildlife habitat development without significant conflicts.

Long-Range Program In the 1980-2000 period, watershed projects would be carried out in five localities and forest land treatment at three locations. Irrigation of 2,000 acres of land is planned. In the 2000-2020 period, there would be watershed projects at eight locations. An additional 15,000 acres would be irrigated. Water supplies would be provided from small headwater reservoirs.

Bitterroot Subarea (Subregion 1)

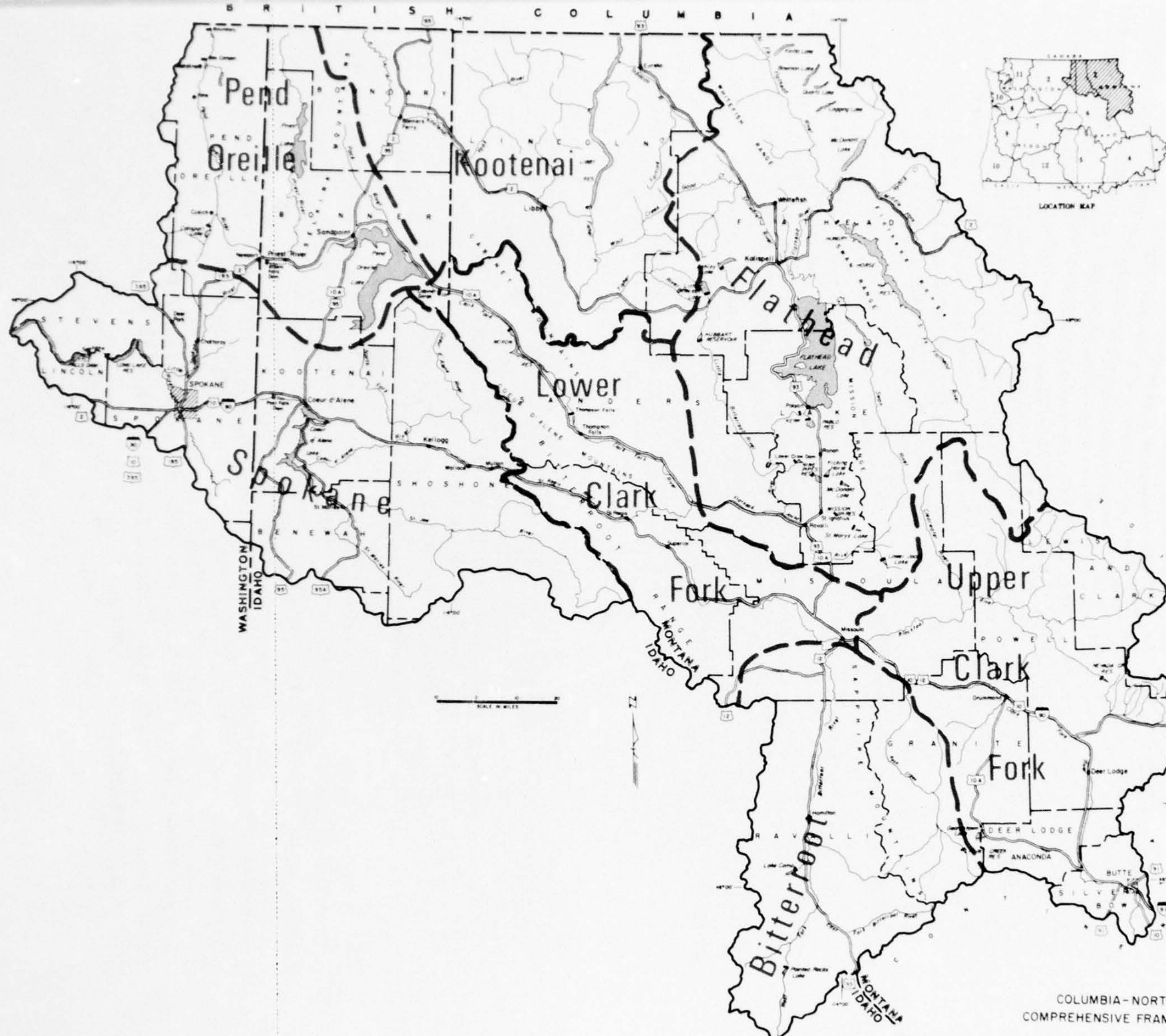
Irrigation diversions deplete the low summer flows of the Bitterroot River curtailing the fishery between the towns of Woodside and Florence where a minimum flow of at least 150 cfs is required. Of the 119,000 acres of irrigated land, about 43,000 acres now experience water shortage. There are 67,000 acres of new land which could be irrigated if water were available. Minor flood damage occurs along the main stem of the Bitterroot River. The primary treatment plant at Hamilton becomes overloaded in the summer from cannery wastes.

Environmental considerations will be given to further agricultural development of the valley bottom lands, early historical settlement sites, and the natural areas of the Bitterroot Mountains.

Adequate storage capacity is available in Painted Rocks Lake on the West Fork for minimum fish flows. However, existing water rights would have to be modified and irrigation diversions monitored to insure that these flows were left in the river. Other alternatives included additional upstream storage, exchange of water rights, and a system of canals and pipelines to serve the valley. Another alternative excluding new irrigated lands was rejected because the basin is oriented towards agricultural development, sufficient lands and water supplies are available, and the food and fiber needs could not be met more economically elsewhere in western Montana. Ground-water information is sketchy and a study should be initiated.

1970 to 1980 Program Selected general solutions include storage of 33,000 acre-feet for irrigation, flood control, and flow augmentation for fisheries downstream from Woodside. The additional flow in summer low flow periods would improve water quality. This storage also would permit irrigation of 19,000 acres of new land and furnish a supplemental supply for 43,000 acres of existing water-short land. Also, modernizing and combining the existing irrigation systems and water districts should be undertaken. Flood plains in Ravalli and Missoula Counties should be regulated to control development. Watershed projects would be carried out at six locations and forest land treatment at two. A scenic road would be designated on the west side of the Bitterroot River and its east fork, and a study made on designation of the Bitterroot below the forks as a recreational river. Other programs for recreation, municipal and industrial water supply, and fish and wildlife habitat development would be undertaken as required to meet demands. Resources are available to accomplish these programs without major conflicts.

Long-Range Program Some of the above programs would continue into subsequent years. In the 1980-2000 period, watershed projects would be undertaken in three locations. Another 1,000 acres of new lands would be irrigated in this period and in the 2000-2020 period through the facilities proposed for the 1970-1980 period.



COLUMBIA-NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

PLAN FORMULATION SUBAREAS

CLARK FORK, KOOTENAI, SPOKANE SUBREGION I

FIGURE 7

Flathead Subarea (Subregion 1)

Major flooding occurs along the Flathead River above Flathead Lake causing extensive flood damages. About 277,000 of the 458,000 acres of potentially irrigable land should be placed under irrigation to satisfy projected food and fiber needs. In addition, 127,000 acres of the existing 153,000 acres of irrigated lands are in need of supplemental water. Constructions at the outlet of Flathead Lake could be removed to reduce flood damage along the lakeshore, and permit full use of the lake storage for regional power and downstream flood control. Discharge of municipal wastes into the slow-moving Ashley Creek at Kalispell is creating a serious pollution problem. Another growing water quality problem is at Flathead and other lakes that are receiving wastes from recreation activities, homes, and other sources. The basin is popular for recreation and fishing opportunities. However, there is a lack of picnicking and camping facilities, hiking trails, and swimming access areas.

Environmental considerations include the potential wild and scenic river classifications for the North Fork and portions of the Middle and South Forks of the Flathead River; the agricultural areas around Kalispell and Flathead Indian Reservation; wilderness areas, Glacier National Park; Flathead Lake, and the rugged timbered mountains surrounding the entire basin.

Alternatives range from full structural development for power, irrigation, flood control, and watershed protection to nondevelopment with the preservation of streams and lakes in their present state and the control of water pollution. Under full development, hydroelectric power could be developed at the Smokey Range site on the North Fork (330 megawatts), at the Spruce Park site on the Middle Fork (380 megawatts), and at two run-of-river plants downstream from Flathead Lake, Buffalo Rapids 2 and 4 (552 megawatts). The Confederated Salish and Kootenai Indian Tribes, in conjunction with the Montana Power Company, have applied to the Federal Power Commission for a license to construct the latter two projects. Irrigation development could be met by direct diversion from the Flathead River and tributary streams, from existing storage at Hungry Horse Reservoir and Flathead Lake, and from various potential storage site locations. Flood protection for Kalispell and vicinity could be met from new upstream storage, levees, and channelization at specific locations between the South Fork and Flathead Lake. Water quality would be improved by control of wastes. There are adequate land and water resources in the basin to satisfy recreation, municipal and industrial water supply requirements, as well as fish and wildlife habitat development.

Because both the problems and their solutions are complex, additional interdisciplinary studies beyond the scope of this investigation are required to formulate the best plan for the basin. At this time the following solutions are set forth for the purpose of this framework study on the basis that the plan would be modified by further studies. Although large storage reservoirs are not included now, future conditions may make the need for additional storage an overriding factor. At that time some of the alternatives rejected herein would be reconsidered.

1970 to 1980 Program The general solutions include a levee to protect the Kalispell area and improvements to the outlets of Flathead and Swan Lakes in the interest of flood control, stabilization for recreation, and increased power production. The improvements to the outlets would be dependent on providing operating plans to avoid adverse environmental impacts and to meet the needs of lakeshore residents for recreational and other uses. Flood plains in Flathead and Lake Counties would be studied and managed to regulate development. Forest land would be treated. Supplemental water supplies for 127,000 acres of water-short land and new water supplies for about 100,000 acres of new land would be supplied by diversions from Flathead River and Lake. A secondary treatment plant would be constructed at Kalispell and the effluent would be carried directly to the Flathead River bypassing Ashley Creek. Additional camping and picnicking sites would be established on Flathead and Whitefish Lakes and a scenic road designated around Flathead Lake. On the basis of studies, a decision would be made on whether the North Fork and portions of the South and Middle Fork should be included in a national system of wild and scenic rivers. A study would be made of ecology at lakes and streams in the Flathead River basin and a plan developed to retain and improve water quality, fish and wildlife, and esthetic values. The designation of the upper Swan as a recreational river and the conversion of part of the west portion of Glacier National Park into a national wilderness would be investigated. The existing inadequate fish passage at the dam below Swan Lake would be rehabilitated. Land for waterfowl management would be acquired or leased north and south of Flathead Lake and near Smith Lake on Ashley Creek. Inclusion of the two run-of-river hydroelectric plants on Flathead River at Buffalo Rapids 2 and 4 is dependent on favorable action by the Federal Power Commission and applicants. Programs for water quality to meet state standards, water supply, fish, and wildlife would be implemented.

Long-Range Program During the 1980-2000 period, additional watershed projects would be undertaken at six locations, another 27,000 acres of new land would be irrigated, more camping and picnicking sites would be constructed, and a scenic route

established up the North Fork of the Flathead. Care must be taken to avoid undue harm to certain fish and wildlife values.

In the 2000-2020 period, watershed projects would be accomplished at six locations. An additional 150,000 acres would be irrigated. Expansion of camping and picnicking sites and associated facilities would continue in accordance with public requirements. Adequate resources are available for providing fish and wildlife habitat and developing proper management programs.

Lower Clark Fork Subarea (Subregion 1)

The Clark Fork Basin from the confluence with the Blackfoot downstream to Lake Pend Oreille has 35,000 acres of land under irrigation of which 4,000 acres are short of water. Water supplies for 95,000 acres of new lands need to be developed to satisfy food and fiber projections. The quality of the water in the stream is reduced by discharge of partially treated sewage from small communities, and wastes from a large pulp and paper plant at Missoula. Water supply for the Missoula Service Area can be supplied from available surface and ground-water sources. Flood damages take place at Missoula and at several other locations downstream. Land treatment and erosion control are needed. There are four hydroelectric plants, one of which can be expanded for peaking purposes. The basin has high environmental and recreation values, excellent sports fishing and key winter big game ranges.

Environmental considerations were the agricultural areas in the river valleys, existing hydropower development on the main stem, fishing streams, and rugged forested mountains enclosing most of the basin.

Alternatives considered were ground-water and surface-water development for the projected irrigation expansion; levees, channelization, and storage for flood control; and multiple-purpose storage on the Clark Fork River to meet hydropower demands, flood control, and irrigation water supplies. Some incidental recreation and fishery could be developed at the reservoir sites. An alternative without hydroelectric and irrigation expansion was rejected because the projects included in the selected plan are needed to meet power and food and fiber needs, and because the development could be accomplished with little change in the basin's environment.

1970 to 1980 Program The general solutions recommended for the 1970-1980 period include the study and zoning of flood plains in Missoula, Mineral, and Sanders Counties to control development. Treatment of forest land would be carried out at three locations. Irrigation of 32,000 acres would be made possible by diversions from the Clark Fork. The water quality of the Clark Fork would be improved to meet State of Montana water quality standards by the installation of waste treatment facilities. A study would be made on designating the Bull River as a recreational stream. Programs for water supply, fish and wildlife, and recreation would be undertaken. Adequate resources are available to meet the program.

Long-Range Program During the 1980-2000 period, watershed projects would take place at five locations and forest land treatment at one location. Irrigation of another 3,000 acres by diversion from the river would be undertaken. The proposed expansion of power facilities at Noxon Rapids would be completed.

In the 2000-2020 period, the levee system at Missoula would be extended and levees constructed at several places on the St. Regis River. Watershed projects would be accomplished at five locations. An additional 60,000 acres would be irrigated as adequate water supplies are available. Measures for water supply, water quality control, and fish and wildlife preservation would be continued.

Pend Oreille Subarea (Subregion 1)

Flood damages occur along the shoreline of Pend Oreille Lake, the Pend Oreille River, and Calispell Creek. Upstream storage provides some protection, and Albeni Falls Dam, downstream from the lake, assists in stabilizing lake levels. However, full control of flooding would require levees or additional upstream storage. Land treatment, erosion control, drainage, and tributary flood protection are required at a number of locations. Although only 8,000 acres are irrigated at the present time, there are 367,000 acres of potentially irrigable land, 49,000 acres of which could be served by pumping from the Pend Oreille River or tributary streams. There is considerable pleasure boating on the lake and river, and transfer of small boats past Albeni Falls Dam has been requested by local interests. The city of Sandpoint discharges sewage with primary treatment into Pend Oreille Lake. Another source of pollution is the lead and zinc mining industry at Metaline Falls. The basin has high recreation values. The Priest River from Canada to its confluence with the Pend Oreille River is under study to determine whether this stream should be included in the national system of wild and scenic rivers.

Protection of the excellent sport fishery in the lake and streams and key big game winter ranges is required. There are three major hydroelectric plants on the Pend Oreille River one of which, the Boundary Project, can be expanded 50 percent over its present installed capacity of 551 megawatts.

The fishery in Pend Oreille Lake, the high recreational use, and the forest covered mountains surrounding and extending into the basin form an attractive setting. These values coupled with agricultural open space around the lake and in river valleys and key big game winter range comprise large environmental assets.

The water rights of the Kalispell Indian Reservation must be considered in the Pend Oreille River Basin planning.

As natural resources are more than adequate to meet future demands placed upon them, limited alternative evaluation was undertaken. One alternative was essentially nondevelopment, with the exclusion of hydroelectric expansion and irrigation from the plan. This alternative was eliminated because the river is already committed to hydroelectric operation, and the irrigation of the farmlands is required to meet food and fiber needs.

1970 to 1980 Program The solutions for 1970-1980 period included a supplemental pumping plant on Calispell Creek to control flooding of agricultural lands. Flood plains in Bonner County, Idaho, and Pend Oreille County, Washington, would be zoned to regulate development. Two watershed projects would be completed and forest land treatment undertaken at six locations. Sixteen thousand acres of land would be irrigated by diversions from the Pend Oreille River and tributaries. Mining wastes at Metalline Falls would be treated. The wild river study on the Priest River will be completed and a decision made as to its inclusion in the national wild and scenic rivers system. A study would be made on designating the Pend Oreille River below Pend Oreille Lake as a recreational river. Abandoned piling in the Pend Oreille River would be removed and a scenic road system designated along the river below Newport, with branches near Newport and Metalline Falls. Lands would be acquired or leased for protection and management of upland game birds. Additional measures to meet recreation, fish, water supply, and wildlife needs would be accomplished.

Long-Range Program During the 1980-2000 period, an additional six watershed projects and three forest land treatment projects would aid in meeting water and related land needs. The proposed expansion of power facilities at the Boundary Project would be completed.

In the 2000-2020 period, levees would be constructed to protect lands along the Pend Oreille River. Nine watershed projects would be undertaken. Careful consideration of fish and wildlife would be required to prevent or minimize losses.

Kootenai Subarea (Subregion 1)

Flooding will be controlled along the main stem of the Kootenai River by the completion of Libby Dam. However, the downstream levees must be maintained to a height commensurate with the discharge from the reservoir. There are many areas requiring measures for land treatment, tributary flood prevention, erosion control, and drainage. About 85,000 acres of the 236,000 acres of potentially irrigable land should be irrigated to satisfy the projected food and fiber requirements; only 9,000 acres are currently irrigated. Flows in the Kootenai River are adequate for municipal and industrial water needs. Vermiculite mining and processing operations upstream from the city of Libby pollute the Kootenai River, and the waters of Koocanusa Lake above Libby Dam may be seriously affected by wastes from gypsum fertilizer production and coal strip mining operations in Canada. The wastes are being monitored and studies of the water quality problems are underway between the two countries. Corrective measures should be taken.

There are significant environmental values in the basin, some of them relating to the Kootenai River and its tributaries as affected by the Libby Project and to the Cabinet Mountains Wilderness. The recreation program at the Libby Project will provide a major recreation development in the basin. The Moyie River, a tributary of the Kootenai River in Idaho, is under study to determine whether it should be included in the national system of wild and scenic rivers. Portions of the Kootenai River and some of its tributaries have high importance for sports fishery and require minimum streamflows and control of developments adverse to fisheries. There are many key winter ranges for big game and habitat areas for upland game birds. The Libby Project is scheduled to have an installed capacity of 420 megawatts by 1976. The capacity is planned to be doubled after 1980 and a reregulating dam constructed with installed capacity of about 50 megawatts. Under the terms of the 1964 Columbia River Treaty, after 1984 Canada may divert part of the Kootenai River flow into the Columbia before it enters the U.S. This possibility is a major consideration in planning the use of the water resources in the basin. Several watershed projects were selected to help meet water requirements.

As the Libby Dam is nearing completion and most of the land to be placed under irrigation is now being farmed, alternatives limiting such irrigation developments were not considered practicable.

1970 to 1980 Program The general program for the 1970-1980 period projects study and regulation of the flood plains in Lincoln County, Montana, and Boundary County, Idaho, to control developments. This program assumes that levees in the Kootenai Flats area will be maintained to heights commensurate with the anticipated discharges from the Libby Project. One watershed project is anticipated and forest land treatment would be accomplished at seven locations. About 25,000 acres would be irrigated with half located along the Kootenai River and the remaining in the Tobacco and Fisher River valleys. Camping, picnicking, and boating facilities would be developed at specific locations to meet recreation demands. Developments would be planned to prevent or minimize fish and wildlife losses.

Under state legislation for water quality control, suspended and settleable solids would be removed from the vermiculite mining and processing operation now discharging into Rainy River, a tributary of the Kootenai. Waste treatment would be provided at municipalities and septic tank installations controlled to meet quality standards. Studies of the water quality problems created by phosphate nutrients from the gypsum fertilizer production and strip coal mining wastes in Canada are underway between the two countries. These studies would be completed. On the basis of the on-going wild rivers study, a decision will be made on whether the Moyie River will be classified under either a state or national system of wild and scenic rivers. Streams tributary to Libby Reservoir valuable for spawning areas would be preserved and improved for propagation or harvest of fish. Future diversions will recognize the minimum flows for production of fisheries.

Areas near Eureka should be acquired for sharp-tailed grouse refuge and along the Kootenai River downstream from Bonners Ferry for additional wetlands for waterfowl.

Long-Range Program During the 1980-2000 period, the power production capacity of the Libby Project would be doubled and a reregulating dam constructed downstream with installed capacity of about 50 megawatts. Three additional watershed projects would be undertaken and forest land treated at two locations. Another 14,000 acres would be irrigated. During the period from 2000 to 2020, seven watershed projects would be completed. Irrigation of an additional 46,000 acres is planned with water to be supplied by pumping from surface sources.

Spokane Subarea (Subregion 1)

Flood damages occur along the Coeur d'Alene River and its tributaries, along Coeur d'Alene Lake, in the valley of the St. Joe River, along Hangman Creek, Little Spokane, and to a minor extent along the Spokane River. Existing waste settling ponds on the South Fork Coeur d'Alene River need protection to prevent damage during floods. Channel improvement for flood control has been authorized along Placer Creek through the town of Wallace. There are many areas requiring watershed treatment, including drainage and erosion control. About 44,000 acres of land were irrigated in 1970. There are 915,000 acres of potentially irrigable land, of which 190,000 acres would be irrigated by year 2020 if a water supply can be provided. About 50,000 acres of the projected irrigated land could be supplied from ground water. The remaining 140,000 acres would require surface-water supply.

About 400,000 tons of logs are towed annually from points along the St. Joe River to mills at the north end of Coeur d'Alene Lake. Conditions of the channel of the St. Joe River near its mouth restrict these log movements. The main municipal and industrial water supply needs are in the Spokane service area, at the city of Coeur d'Alene, and in the vicinity of Kellogg, Idaho. These needs can be satisfied from both surface and ground water without problems. Municipal and mining waste disposal on the South Fork of the Coeur d'Alene River causes a serious water pollution problem, as does drainage from mining tailings which continually release toxins. Application of secondary treatment to Spokane's municipal and industrial waste, although reducing the oxygen deficiency and growth of algae downstream, would still produce an effluent which cannot be diluted adequately by the low summer flow in the Spokane River. There is a possibility also of contamination of ground water in the Spokane area from septic tank discharges.

There are outstanding environmental considerations in the area. The St. Joe River is under study to determine whether it should be included as part of the national wild and scenic rivers system. There are needs for additional facilities for camping, picnicking, and boating; for access to additional recreation, fishing, and hunting areas; and preservation of streams and historical areas. Streams tributary to Lake Coeur d'Alene are valued for spawning and should be protected or reclaimed. Establishment of minimum flows for fisheries and the acquisition of wildlife habitat are requirements.

There are seven small hydroelectric plants on the Spokane River. A number of potential hydroelectric sites remain on the Coeur d'Alene River.

AD-A036 571 PACIFIC NORTHWEST RIVER BASINS COMMISSION VANCOUVER WASH F/G 8/6
COLUMBIA-NORTH PACIFIC REGION COMPREHENSIVE FRAMEWORK STUDY OF --ETC(U)
JUN 72 E J GULLIDGE, H H RALPHS, C STEWART

UNCLASSIFIED

NL

3 OF 7
AD
A036571

The water rights of the Spokane and Coeur d'Alene Indian Reservations must be considered in Spokane River Basin planning.

The basin is faced with serious water supply and quality problems. Augmentation of the streamflows of the Spokane River is needed for water quality and fisheries. Irrigable lands could be served by high-lift pumping from the Spokane River or low-lift pumping from the Pend Oreille River during spring runoff. Diversions from the Spokane River would reduce its capability to carry waste treatment plant effluents and also would conflict with power production and the resident fishery.

There are a number of alternative plans, some of which conflict with environmental quality. Upstream reservoirs on Coeur d'Alene River could store up to 250,000 acre-feet to augment low water flows to aid in flood control and provide water for irrigation, water quality, power, recreation, and fisheries. However, the reservoirs would inundate areas of high environmental value. In addition, this alternative would require legislation in Idaho to allow storage of water for irrigation use in Washington. Another alternative would provide offstream storage for irrigation with high-lift pumping from the Spokane River but would further reduce the low flow of the river with adverse effects on water quality, the resident fishery, and power. Another alternate, with low-lift diversion from the Pend Oreille River into offstream storage, could satisfy irrigation and provide some return flows into the Spokane River to augment streamflows. Limiting irrigation to presently available water would not solve the water quality problems during summer low flows in the Spokane River. Nondevelopment would not solve any of the current problems.

The problems in the Spokane Basin require detailed investigations beyond the scope of this study to determine the best plan. For the purpose of this framework study, the following plan was utilized on the basis that it could be modified as the result of further study.

1970 to 1980 Program The plan for the early period includes levees on Pine Creek at Pinehurst and at the town of Pine Creek and reconstruction of the Placer Creek channel through Wallace. Flood plains in Shoshone, Kootenai, and Benewah counties, Idaho, and Spokane County, Washington, would be regulated to control development. Three watershed projects would be carried out and forest land treatment completed at three locations. Irrigation of 82,000 acres is included in the plan. Of this amount, 33,000 acres could be supplied by known sources of ground water.

Waste disposal into Coeur d'Alene and Spokane Rivers and their tributaries would be controlled to meet state standards; a total wastewater management study would be made to determine sources of nutrients and pollutants entering Coeur d'Alene, Hayden, Spirit, and Twin Lakes, and necessary corrective action to be taken. Mine waste settling ponds on the South Fork would be made more effective in removing toxins and protected against inundation by flood waters. Water supplies are adequate for municipal and industrial needs. Treatment would be employed when required. Additional recreation, boating, and other facilities would be provided. Streams tributary to Lake Coeur d'Alene would be preserved and protected as spawning habitat areas. Scenic roads would be designated on the Spokane and Little Spokane Rivers and to the west and southwest of Spokane. A study would be made on designating the Spokane as a recreational river. Minimum flows for fish and other purposes would be established. Wetlands in the lower Coeur d'Alene Valley near Rose Lake would be acquired or leased for waterfowl management. The wild and scenic river study on the St. Joe River will be completed and a decision made on what sections qualify for inclusion in the national wild and scenic rivers system.

Long-Range Program An additional 16 watershed projects, and forest land treatment measures at 3 locations would be implemented during the 1980-2000 period. Irrigation of 34,000 acres is included. Levees would be improved at two locations. Storage would be studied on the Coeur d'Alene River to augment low flows in the Coeur d'Alene and Spokane Rivers to improve water quality, reduce flood damages, stabilize lake levels and provide water for irrigation and power. The mouth of the St. Joe River might be improved for navigation of towed log rafts, depending on feasibility and its status in the national wild and scenic rivers system.

In the 2000-2020 period, watershed projects would take place at 15 locations. Irrigation of 74,000 acres would be developed.

Main Stem of the Upper Columbia River (Subregion 2)

The main stem of the upper Columbia River to the Canadian border contains a series of seven dams and reservoirs leaving 57 miles of open river below Priest Rapids Dam. With completion of the Columbia River treaty projects previously described herein and in Appendices VII and X, a substantial amount of storage will be added to the system for regulating the seasonal fluctuation. As electric power generation shifts to a thermal

base, the hydroelectric projects would be operated more and more for peaking, and planned additional generation would be for peaking purposes.

The shorelands, particularly in the Hanford area, are suitable for thermal electric installation for transmission to the densely populated coastal area in the Willamette-Puget Sound trough. Navigation upstream from the lower river is not possible at this time because of shallow bars in open river stretches and barriers formed by dams. However, the Federal Power Commission license for the dams below Chief Joseph Dam includes provisions for future locks when justified.

The shorelands have a potential use for industry, residences, recreation and wildlife.

The river has geologic, historic, and unique areas and high environmental values, including fish and wildlife, recreation, and esthetics, that should be preserved.

There is need for reducing supersaturated levels of nitrogen below storage projects which occur when high spring runoffs require use of spillways. Water quality control is needed to insure that Federal-State standards are met. The desires and water rights of the Colville Indians must be included in any long range planning.

Pleasure boating use, both from local residents and boaters living out of the area, is increasing. Additional moorages and related boating facilities are needed.

Three alternatives viewed for the subarea range from severely restricting future development to significant additional installation of structures. For all alternative schemes, the authorized and planned additional generating facilities would be added to the existing upstream dams.

One alternative, and the most restrictive, would be to classify the segment of the Columbia River from Priest Rapids Dam to Lake Wallula (McNary pool) as a scenic or recreation river. This reach is currently designated for such study under section 5(d) of Public Law 90-542. If this alternative were selected, the river would remain in its present state and flow fluctuations, due to power peaking operation, would be controlled to harmonize with wildlife and recreational use. This alternative would have the minimum environmental impact but navigation would not be provided and substitute facilities for electric power would be required to provide the capability foregone.

Another alternative would provide for dredging of a channel for the 57-mile stretch of river below Priest Rapids Dam and construction of locks at upstream dams to provide shallow-draft navigation to Wenatchee. Recent studies have shown that shallow-draft navigation would allow movement of more than 4 million tons of commodities by 1980 at less cost than land transportation. However, unless properly controlled, both the disposal of dredging material and the timing of construction could affect the spawning of anadromous fish in the river and have some effect on sports fishery. Peaking operation of the upstream dams would not affect navigation. This alternative could be further modified to include such adjustments as can be made in minimum releases at Priest Rapids Dam to reduce the extent of channel dredging, thus minimizing environmental impacts.

A third alternative would comprise Ben Franklin Dam, some dredging at the head of McNary pool, and navigation locks at the three upstream dams to allow shallow draft navigation to Wenatchee. Ben Franklin Dam would be a multiple-purpose development about 49 miles below Priest Rapids Dam. It would have an installed capacity of 938 megawatts and generate an average of 428 megawatts, and would serve to damp out flow fluctuations caused by peaking operations of upstream dams to and including Grand Coulee. The alternative would benefit recreational and commercial navigation and permit maximum peaking power with minimum river fluctuations but would have the maximum environmental impact.

Before any of these alternatives can be selected, detailed interdisciplinary studies would be required to establish the effects of peaking operations, channel dredging, and additional power development on the area's environment.

For the purpose of this framework study, the alternative providing for extension of barge navigation to Wenatchee with a dredged channel and locks in three existing dams in the period 1980 to 2000 was used on the basis that it could be altered to conform to the results of further studies. This alternative appeared to provide significant economic advantages to Central Washington with the least adverse environmental impacts.

<u>1970 to 1980 Program</u> In the 1970-1980 period, three units in addition to those existing and under construction would be installed to raise the capacity of Grand Coulee project by 1,800 megawatts and 11 generating units would be added to Chief Joseph Dam, raising the installed capacity by 1,045 MW. The hydroelectric plant at Rock Island Dam would be expanded by 350 MW and it and other plants would be modified and operated to reduce nitrogen concentrations. A thermal generating plant of 1,100 MW capacity would be constructed. The existing 800 MW plant at Hanford may be phased out. Waste treatment facilities

would be installed as required to meet Federal-State water quality standards. Fish and wildlife habitat would be preserved by leasing or acquisition of lands. Additional recreational facilities would be constructed. A plan for a scenic parkway along the river would be implemented. Municipal and industrial water supply needs would be met from existing sources.

Long-Range Program From 1980 to 2000, the capacity of the Grand Coulee Project would be raised 3,794 MW by the addition of six units at the dam and four units at the pumping plant. Six units would be added to the Wanapum Project, increasing the capacity by 498.8 MW. The need for additional generating units at Chief Joseph Dam beyond those now in place and authorized would be determined. An additional 2,900 MW of thermal power would be constructed, using cooling towers or ponds for dissipation of heat. Navigation would be extended to Wenatchee by the construction of a dredged channel and three locks. Programs for water quality control, fish and wildlife, recreation, and preservation of environmental values would be continued. During the period from 2000 to 2020, thermal electric plants with a total capacity of 7,000 MW with cooling towers or ponds would be installed.

Big Bend Subarea (Subregion 2)

The Big Bend Subarea (figure 8) comprises a relatively high plateau lying south and east of the Columbia River in Washington. Crab Creek is the main drainage basin. Moses Coulee and minor streams drain the northwest portion into the Columbia River. Crab Creek Basin experiences recurring flood damages, particularly at the towns of Odessa, Wilson Creek, and Ephrata. Also, damages occur to 1,500 acres of agricultural land in Moses Coulee where floods occasionally deposit silt and sand over a portion of Palisades Irrigation District. Floods in Esquatzel Coulee cause damages to the town of Mesa. Upstream storage, channelization, and levees are alternatives which could reduce flooding. Flood plain regulation would be effective in reducing the growth of future damages.

Irrigation is practiced on 702,000 acres. The largest block of irrigated land is in the Columbia Basin Project, where an additional 561,000 acres remain to be developed. The water supply for this ultimate 1.1 million acre project has been provided through construction of Grand Coulee Dam and Banks Lake. In addition to the Columbia Basin Project, there are 1,260,000 acres of potentially irrigable lands. Water supplies for 482,000 acres located adjacent to the project could be obtained by pumping from either Banks Lake or Roosevelt Lake. Offstream storage might be desirable for much of the other potentially irrigable

lands which are farther from these water sources. Ground water in some areas is overappropriated and the state has taken steps to curtail its use for irrigation.

At some locations, ground water has excessive nitrate-nitrogen concentrates. Seasonal low flows in some reaches of Crab Creek are inadequate to dilute agricultural return flows and wastes from feedlots. Water quality is not satisfactory in many reaches of the stream.

Below O'Sullivan Dam, Crab Creek has potential for development of anadromous fish spawning grounds. However, streamflow increases are necessary to overcome restrictions on current fish production, as well as to enable implementation of enhancement measures. The Columbia Basin Project has provided resting, nesting, and feeding habitat for large populations of waterfowl and upland game birds. Leasing or acquisition of additional areas along future canals, wasteways, laterals, and other irrigation associated wetland areas would enable an increase in bird populations and hunting opportunities. Development of access sites along publicly held rights-of-way would help provide free hunting access. The current resident fish management program is adequately meeting present demands for lake and reservoir fishing and is expected to continue.

The area has unique geologic formations of scenic value and considerable opportunities for increased recreation activity, particularly at Pot Holes Reservoir and at several seep lakes.

Accelerated watershed development is required at several locations. Although there are no apparent conflicts among projected resource uses in the area, the complexity and magnitude of solutions considered warrant detailed interdisciplinary studies. Accordingly, the following framework plan could be altered by the findings of future studies.

<u>1970 to 1980 Program</u> The framework plan includes channel improvement on Crab Creek at Odessa and on Dry Creek at Ephrata. The development of the flood plains of Crab Creek, its tributaries, and other streams would be regulated through zoning. Flooding and deposition of debris on lands in Moses Coulee would be examined to determine the land measures required to reduce damages.

Land treatment measures are proposed for eight watersheds to remedy problems of water conservation, erosion control, and flooding on tributaries.

To meet projected food and fiber needs, an additional 460,000 acres would be irrigated by 1980. As the Columbia Basin

Project is an authorized project and has its water supply developed and main project features constructed, it is logical that irrigation expansion would be continued in this area first.

Municipal and industrial water supply needs would be met from existing sources through expanded conveyance systems.

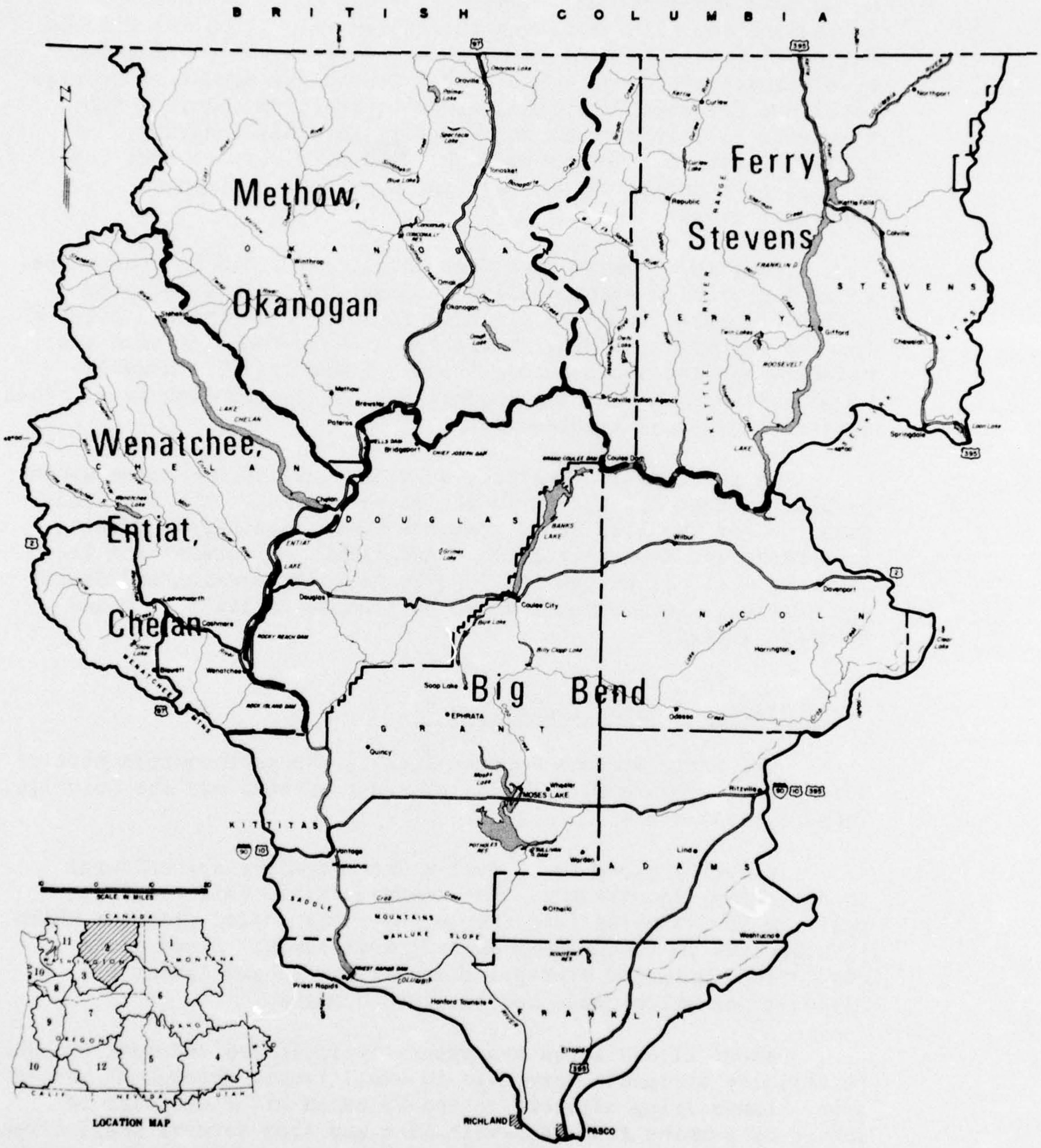
Compliance with Federal-State water quality standards would be obtained by installation of additional waste treatment and sewage collection facilities. A comprehensive sewage drainage basin plan would be developed for water quality control and pollution abatement.

There are adequate public lands and sufficient water areas which can be used to satisfy recreation needs. Approximately 740 acres of land would be developed adjacent to water areas by 1980 to meet the swimming, boating, camping, and picnicking needs.

Waterfowl habitat lands would be acquired and habitat areas along irrigation canals, laterals, and waterways obtained and developed for game bird use and hunter access. An upland bird game farm would be constructed within the subarea. Wet areas resulting from the Columbia Basin Project would be acquired or leased and developed for upland birds and waterfowl.

Long-Range Program During 1980 to 2000, the town of Mesa in Esquatzel Coulee would obtain protection against floods up to 100-year level of recurrence with the construction of levees above the town. Additional structural measures, continuing land measures, and watershed management programs would be needed in five watersheds. An additional 187,000 acres are projected to be irrigated. Approximately 118,000 acres would be placed under irrigation in the Columbia Basin Project, completing the 50-year project development and bringing 1,068,000 acres under irrigation. Thirty thousand acres of new land on the plateaus east of Banks Lake would be irrigated with water pumped from Banks Lake and diverted into project canals.

Sylvan Lake upstream from the town of Odessa would be enlarged in excess of 100,000 acre-feet or an alternate reservoir constructed to provide irrigation water supplies for 32,000 acres prior to year 2000, and ultimately a total of 150,000 acres between Davenport and Washtucna. The water supplies would be pumped from Roosevelt Lake and conveyed to Sylvan Lake for use during the irrigation season. Construction of Sylvan Lake Reservoir would provide flood protection to Odessa and other Crab Creek areas, recreation and fishing opportunities, and additional flows for fish and water quality in Crab Creek.



COLUMBIA-NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

PLAN FORMULATION SUBAREAS

UPPER COLUMBIA SUBREGION 2

FIGURE 8

Several potential pumped-storage hydroelectric projects using Lake Roosevelt as a lower reservoir could be developed in conjunction with providing irrigation water supplies for the Davenport-Washtucna area. The size of Sylvan Lake enlargement or alternative storage would be related to the amount of storage developed for power. Further study is required before a firm reservoir size is determined; however, for this analysis, 1,035,000 acre-feet of water is assumed necessary to meet the multipurpose objectives in the Crab Creek and Davenport-Washtucna areas.

Additional waste treatment facilities would be constructed to meet projected water quality requirements. Water related recreation areas would be expanded to include additional picnicking and overnight camping facilities. Improvement of fish and wildlife habitat would be continued. Lower Crab Creek would be developed as a spawning channel for anadromous fish if detailed studies indicate its suitability.

In the 2000-2020 period, an additional 10,000 acres would be placed under irrigation in the eastern part of the Big Bend area. Water supplies would continue to be obtained by pumping from Banks and Roosevelt Lakes. Additional structural and land measures would be needed in 21 watersheds for erosion and drainage control. Developments would be planned to limit fish and wildlife losses.

Ferry Stevens Subarea (Subregion 2)

The Ferry Stevens Subarea lies in the northeastern part of Subregion 2 (figure 8). The major river systems are the Colville, Sanpoil, and Kettle.

Flooding along the Colville River damages agricultural lands, roads, and bridges. The channel of the Colville River upstream for 48 miles from Kettle Falls has a flat gradient which is conducive to flooding of agricultural lands. Flood plain regulation, upstream storage, channelization, and levees are alternatives which could reduce flood damages.

About 21,000 acres are presently irrigated and some 376,000 potentially irrigable acres lie in small tracts throughout the subarea. Lands lying adjacent to the Columbia River can best be served by pumping from Roosevelt Lake and from several small streams. In the Colville River Valley, potentially irrigable lands could be served from surface and ground water without new storage. Sources for municipal, industrial, and rural-domestic water supplies are adequate.

Lake and ground-water pollution around intensively developed recreational properties poses a serious problem. Examples are Loon and Deer Lakes where lake water quality has been a problem for several years. Correction requires

collection and treatment. Total coliform organisms have exceeded recommended limits in the lower Colville River. However, this can be alleviated with additional treatment facilities and correction of inadequate septic tank installations. Low flow augmentation would also improve water quality.

The Kettle River drainage has erosion and water quality problems.

The entire Sanpoil River and its West Fork warrant consideration for possible inclusion into a state or national system of free flowing streams. Improved habitat areas for big game are needed as are increased opportunities for fishing and hunting.

The framework plan for the Ferry-Stevens Subarea would include studies of the main stem and West Fork Sanpoil Rivers to determine whether they should be preserved as recreation rivers; channelization along the lower Colville River for flood protection; provisions for diverting an additional 52,000 acre-feet of ground and surface water for irrigating 23,000 acres of new lands; setting aside some wildlife habitat areas for big game; and management programs for the enhancement of all resource uses.

An alternative which would eliminate flood protection and irrigation on the Colville River was rejected because of lack of response to needs. Also, the adopted plan would result in little change to existing environmental values. The main stem and West Fork of the Sanpoil River are located predominately on the Colville Reservation, and, as such, any long-range planning for this area must include the views of the tribe.

1970 to 1980 Program   Developments in the flood plain would be regulated. An additional 3,000 acres would be irrigated from ground-water sources in the Colville River Basin. Necessary erosion control and water quality measures would be undertaken.

The municipal and industrial water distribution systems would be expanded to meet future demand. Water quality needs would be met by installation of municipal and industrial waste collection and treatment facilities as required to meet Federal-State water quality standards.

A study would be made of the West Fork and main stem of the Sanpoil River to determine their desirability as recreation rivers. A comprehensive sewage drainage basin plan would be proposed for water quality control and pollution abatement. Overnight camping areas would be expanded and new campgrounds constructed. Big game habitat areas would be acquired and management programs expanded.

Long-Range Program During 1980 to 2000, the channel of the Colville River from Kettle Falls to Deer Creek would be improved for flood control. Land treatment measures in six watersheds would remedy problems of drainage and erosion control. Diversions from ground water and from Roosevelt Lake would provide the necessary water supplies to irrigate an additional 10,000 acres of new lands. Expansion of municipal and industrial water supply conveyance facilities would satisfy projected needs. Additional waste treatment facilities would meet the projected water quality requirements. Expansion of existing facilities and acquisition of additional lands for recreation use would continue. All developments would be planned to avoid environmental damage.

In the 2000-2020 period, an additional 10,000 acres are projected to be irrigated by private development. Water supplies could be obtained by pumping from Roosevelt Lake and from ground-water sources.

Measures for erosion control, drainage, flood prevention, and water development for part of the requirements would be needed in 13 watershed areas.

Methow-Okanogan Subarea (Subregion 2)

The Methow and Okanogan River Basins lie in the northwest portion of the upper Columbia River area (figure 8). The Methow River drains the eastern slope of the Cascade Range. The Okanogan River and its main tributary, the Similkameen River, derive 71 percent of their runoff from Canada. About 500,000 acres of the Colville Indian Reservation are within the Okanogan River Basin, and the water rights of the Colvilles must be considered in planning for the basin.

The Methow River Basin is served by paved roads and soon will be connected to the upper Skagit Basin via the North Cross-State Highway. This route will make the valley the eastern gateway to the North Cascades National Park. The ensuing developments, both recreational and service facilities, will require detailed planning of water and related land resources to avoid large losses of environmental values.

The developed bottom lands of the Methow River Basin, which are subject to flooding, comprise about 2,500 acres of town and farms. High flows carry large debris loads and cause severe bank erosion. During high flows, portions of the towns of Twisp and Winthrop are flooded, and bridges along the entire river are damaged through the erosion of abutments. Average annual damages are estimated at $30,000, mostly to agricultural

lands. Flood plain regulation and levees are alternatives which could reduce the level of flood damages.

Frequent floods on the Okanogan River inundate agricultural land and damage rural homes and residential areas in Omak, Okanogan, and Oroville. Also, sections of highways are inundated. Higher, less frequent floods damage residential and commercial buildings at Oroville, Tonasket, Riverside, Omak, and Okanogan, as well as many farm buildings throughout the valley. Considerable damage occurs to highways, community water systems, sewage treatment plants, and the railroad. Average annual flood damages are $425,000 in the United States. At times, the Similkameen floods at a higher level than the Okanogan, creating a reversal of flow into Osoyoos Lake in Canada, damaging homes around the lake. Flood plain regulation, levees, and upstream storage would be effective in reducing flood damages in the Okanogan Basin.

The Okanogan River Basin experiences shortages of water during the growing season which curtail irrigation and increase the severity of water quality problems in both Canada and the United States. The increase in recreation and tourism, together with the restricted access to major sport fish and game resources, are also problems.

About 74,000 acres are presently irrigated and 150,000 acres are potentially irrigable. Potential irrigable lands are generally in scattered small tracts and the majority are on high benches bordering the rivers. Natural flows in the Okanogan River are inadequate for future irrigation expansion without upstream storage. Some lands, including 10,000 acres on the Colville Indian Reservation, could be served by diversions and pump lifts from the Columbia River.

Adequate water to meet future municipal and industrial needs can be developed by expanding existing facilities. Industrial waste treatment practices are generally excellent. Except for temperature problems, high coliform bacteria levels, and a shortage of natural flows on the lower Okanogan River during the late summer months, there are few cases where water quality degradation has occurred in the streams or lakes of the area.

The recreation attractions are the alpine and large upland lakes, rugged country for hiking and packing, and the excellent big game hunting. Some of the principal streams of the area warrant study for inclusion in a state or national recreation river system.

The Okanogan River supports important steelhead and blueback, chinook and coho salmon runs which should be preserved and possibly enhanced. Fish and game habitat improvement, removal of fish passage barriers, and artificial propagation are alternatives which would help meet future fishing and hunting needs. The key to meeting much of Washington's future big game hunting needs rests heavily upon preservation of existing key winter ranges in these basins.

There is also a need for resource development on the Colville Indian Reservation to yield economic benefits to the Indians.

Upstream storage of 600,000 acre-feet would be necessary to satisfy all water needs of the Okanogan Basin for irrigation, water supply, flood control, and low flow augmentation for water quality and fish. Sites entirely within Washington are inadequate. A suitable site on the Similkameen River just above its confluence with the Okanogan would store up to 600,000 acre-feet, but the reservoir would inundate agricultural lands, some of which are in Canada. Available information indicates that there are adequate storage sites on tributaries of the Similkameen River in Canada which could meet the downstream water supply and control needs for the United States as well as meet some Canadian needs.

Alternatives range from upstream storage in Canada, to modernizing and improving existing irrigation systems without storage. Flood plain regulation; water quality treatment; and fish, wildlife, and recreation programs would be part of all alternative plans.

A 350,000 acre-foot reservoir on the Similkameen River, which would back water up to the Canadian border, would provide most of the needed flood control storage and water for irrigation, minimum fish flows, and water quality. Another alternative includes storage at Palmer Lake, which would be adequate for meeting only a part of the irrigation water supply and limited recreation and fishing opportunities. The lake is presently used for recreation, fishing, and irrigation, although current use is not extensive. Raising the natural lake level for additional storage would inundate some big game winter range, orchards, and meadow lands while lowering the lake would leave some beach areas exposed. Further analysis must be made to determine if Palmer Lake can be used without incurring detrimental side effects to the environment. Canada has a 4-year study of the Okanogan River Basin underway for completion in 1973. Accordingly, the plan recommends early coordination with Canada with a view of arriving at solutions to the Okanogan water problems.

There is an urgent need for an interdisciplinary study fully coordinated with the ongoing study in Canada to determine the proper plan for handling water and related land resources. Such an investigation is beyond the scope of this study. Accordingly, the following plan is used for the purpose of this study on the basis that it could be modified to reflect the findings of further detailed investigations.

1970 to 1980 Program During the early time period, growth in flood damages would be reduced through management of the flood plains in the Methow and Okanogan Basins. Logs and other debris would be removed from the Methow River channel to reduce the danger of damage to bridges and the erosion of banks during high flows. Land use planning of the Methow River shorelands as a cooperative effort between the state and the county would place controls on development resulting from construction of the new cross-state highway.

Irrigation development of 13,000 acres is projected along the Okanogan River. Approximately 20,000 acre-feet of storage within the United States would supply water for irrigating 10,000 acres of new lands. The remaining 3,000 acres could be served by diversion of surface water. Mitigation of unavoidable big game losses would be accomplished.

Municipal and industrial water supplies are expected to be obtained from both ground and surface sources, which are adequate to meet future needs.

Water quality needs would be met by additional waste collection and treatment facilities installed by municipalities and industries. A comprehensive sewage drainage basin plan would be prepared for water quality control and pollution abatement.

Studies would be made of the Okanogan and Methow Rivers to determine their suitability for inclusion in a national or state system of recreation rivers.

Camping areas would be expanded as these basins receive high visitation from the populous Puget Sound area. Development of hiking and riding trails, historic interpretation, and nature walks would be accomplished within flood plains near urban areas through county, state, and local planning.

Long-Range Program During 1980 to 2000, levees would be installed along the Okanogan River at Oroville, Riverside, Omak, and Okanogan. Fourteen watershed programs would be undertaken for erosion and sediment control, drainage, flood prevention, and watershed protection.

Additional waste treatment facilities would be installed to meet the projected water quality requirements.

No storage is included in the plan for the Okanogan River Basin at this time, although follow-on studies may show upstream storage to be needed and feasible. Additional water would not be available for water quality improvement, fish, irrigation, recreation, and other uses. An additional 13,000 acres in the second time period would be irrigated by pumping from other surface and ground-water supplies. This includes 10,000 acres of the Colville Indian Reservation that would be served by Columbia River water and some local sources.

Recreation areas would be expanded to include additional picnicking and overnight camping facilities. Fish passage facilities would be provided on the Similkameen River. Waterfalls and barriers to fish passage would be laddered or removed on the Methow River. Aerators would be installed to prevent winter kill, increasing production levels, and passage facilities would be installed at fish barriers to enhance fishing success in some area lakes.

In the 2000 to 2020 period, the water supply for 10,000 acres of additional irrigation would be obtained from sources other than major storage. Seven additional cooperative watershed programs for erosion and drainage control, water supply and conservation, and watershed protection would be accomplished.

Wenatchee, Chelan, and Entiat Subarea (Subregion 2)

The Wenatchee, Chelan, and Entiat Rivers drain into the Columbia River from the east slopes of the Cascade Mountains.

High flows of the Wenatchee River cause flooding of low lying rural areas near Cashmere and Monitor. Estimated average annual damages are $150,000, for the most part to transportation facilities.

The city of Wenatchee is subject to damages from floods in Canyons 1 and 2, which flow through the city to the Columbia River. Significant damage has occurred about every 10 years. Approximately 2,900 acres of land are subject to inundation. Debris is deposited in agricultural and urban areas and city streets are flooded, overloading sewers. Congress authorized in 1970 the construction of a flood channel to solve this problem. Average annual damages amount to $400,000, mostly urban.

In the Entiat River Valley, 2,500 acres of irrigated farms near the river mouth are subject to flooding. During floods, the very steep gradient of this stream causes severe erosion. Average annual damages are estimated at $32,000, about 25 percent of which are to urban and transportation facilities.

The existing irrigated land comprises 15,000 acres in Wenatchee, 5,600 acres in Chelan, and 1,900 acres in Entiat River Basins. Fruit orchards predominate. The potentially irrigable land is 9,100 acres with 4,500, 3,800, and 800 acres in Chelan, Wenatchee, and Entiat Basins, respectively. There is sufficient water available for irrigation from surface waters.

The primary water related land use problem is bank erosion. In rangeland areas, protective measures are needed to retard runoff, reduce erosion, and improve infiltration to the ground-water aquifers.

The water rights of the Chelan Public Domain Allotments must be considered in planning for the Chelan River Basin.

There is a hydropower project at the outlet of Lake Chelan. Chelan County PUD No. 1 has filed an application with the Federal Power Commission (Wenatchee Project No. 2151) for four power dams on the Wenatchee River. This proposed development would conflict with a designation of this river under Section 5(d) of P.L. 90-542 for study as a possible scenic or recreation river. The decision on whether to construct these projects rests with the Federal Power Commission.

Chelan County PUD No. 1 is conducting a detailed study of a pumped storage project at Antilon Lake, about 6 miles north of Mason, Washington. Lake Chelan would serve as the lower reservoir and Antilon Lake, about 1-1/2 miles to the east and about 1,300 feet higher, would be enlarged. The proposed output would be 1 million KW; in addition to power, the project would provide recreation and furnish water supply for irrigation.

There is adequate water from existing sources to meet future municipal and industrial water demands.

In general, there are only a few cases where water quality degradation has occurred in the streams or lakes of the area.

The recreation attractions are the alpine and large upland lakes, rugged country for hiking and packing, and excellent big game hunting. New camping and picnic areas are needed. The unique attractions include the Lake Chelan National Recreation Area, Glacier Peak Wilderness, the Stehekin River, Eldorado Peaks, and North Cascades National Park. Some of the principal streams

of the area should be studied for inclusion in the wild and scenic rivers system.

Increased opportunities for fishing and hunting are needed. Alternatives include habitat improvement, removal of barriers, and artificial propagation. However, the key to meeting future big game hunting needs rests heavily upon preservation of existing key winter ranges. Changing cropping patterns and expanding agriculture in the lowland areas would eliminate some key winter range.

The following framework plan was selected after consideration of nondevelopment alternatives. The elements in the plan would be expected to have little adverse environmental impact and would meet the projected needs. Detailed followup studies may alter these findings.

<u>1970 to 1980 Program</u> During the 1970-1980 period, flood plain regulations would be implemented to control development. Flood damages in Wenatchee from Canyons 1 and 2 would be alleviated by an authorized project which provides for open and covered channels to carry floodflows to the Columbia River.

Two watershed projects would be undertaken south of Wenatchee to help remedy problems of cropland wetness, erosion, and water management and supply. No additional irrigation development is projected for either the early or long-range programs.

Both ground and surface-water supply sources are adequate to meet future municipal and industrial needs. Additional waste treatment facilities would be installed by municipalities and industries to meet Federal-State water quality standards. A comprehensive sewage drainage basin plan would be proposed for water quality control and pollution abatement.

Camping areas would be expanded in the Cascade area of the Wenatchee and Chelan drainages as these areas receive high visitation from the populous Seattle area. Development of hiking and riding trails, historic interpretation, and nature walks would be accomplished within flood plains near urban areas through county, state, and local planning. Studies would be made of the Wenatchee, White, Chiwawa, Little Wenatchee, and Entiat Rivers to determine their suitability for inclusion in a state or national system of wild, scenic, or recreation rivers.

Fish passage facilities would be developed at manmade and natural barriers at Dryden Dam, Leavenworth Dam, Tumwater Dam, and the 30-foot falls on the Wenatchee River to provide

additional spawning and rearing areas for anadromous fish. Additional fish passage facilities would also be provided at river mile six on Little Wenatchee River. Additional wildlife recreation areas would be established in Chelan, Colockum, McThau, Cottonwood Creek, and Lime Belt areas primarily for big game.

Long-Range Program During 1980 to 2000, programs started in the early period would be continued. Twelve miles of setback levees on the Wenatchee River below Leavenworth would be constructed to protect agricultural and urban lands from flooding along the lower 24 miles of the river. The existing power plant at the outlet of Lake Chelan would be expanded by 224 MW.

Additional waste treatment facilities to raise the level of treatment to 90 percent BOD removal would be installed to meet the projected water quality requirements.

Waterfalls and barriers to fish passage would be laddered or removed by 1990 in the Chiwawa and Methow Rivers. Installation of aerators to prevent winter kill, increasing water levels, and installing fish barriers are potential management measures to enhance fishing success in some lakes.

In the 2000 to 2020 period, the water and land management programs would be continued. Long-range projections of needs for municipal and industrial water supply, waste treatment, and recreation can be satisfied through expansion of facilities and maintenance of ongoing programs.

Additional structural and land treatment programs would be included for erosion and drainage control and watershed protection. Six watershed areas are programmed.

Fish and wildlife programs would be continued. It is probable that accelerated artificial propagation measures will become necessary during this time period. Maintenance of adequate big game populations to satisfy hunting needs would depend primarily on protection of key winter ranges from noncompatible uses.

Yakima River Basin (Subregion 3)

The Yakima River Basin's present and future prosperity is closely linked to the quantity and quality of its water supply. Irrigation diversions and return flows, municipal and industrial waste effluents, and farm animal wastes are major factors presently affecting quality of the Yakima River. Increased stream temperatures, excessive aquatic growths, high turbidity, sediment, and bacterial organisms are present in the lower reaches of the river

and have curtailed multiple-purpose uses. Increased regional growth without adequate safeguards would cause further reduction in Yakima River water quality and quantity.

The basin is subjected to recurring flood damages. Flood susceptible areas include irrigated farmlands and portions of Yakima, Ellensburg, Toppenish, and several small towns and communities. Complete control for a 100-year flood would require 675,000 acre-feet of suitably located storage. Over half of this total could be provided at existing reservoirs, and the remainder would have to be developed at new sites. New and improved levees could provide additional protection along the Yakima and Naches Rivers. Flood plain zoning would be effective in stemming the growth in flood damages by restricting new developments in flood hazard areas. Other flood plain management measures include flood proofing, warning systems, and insurance.

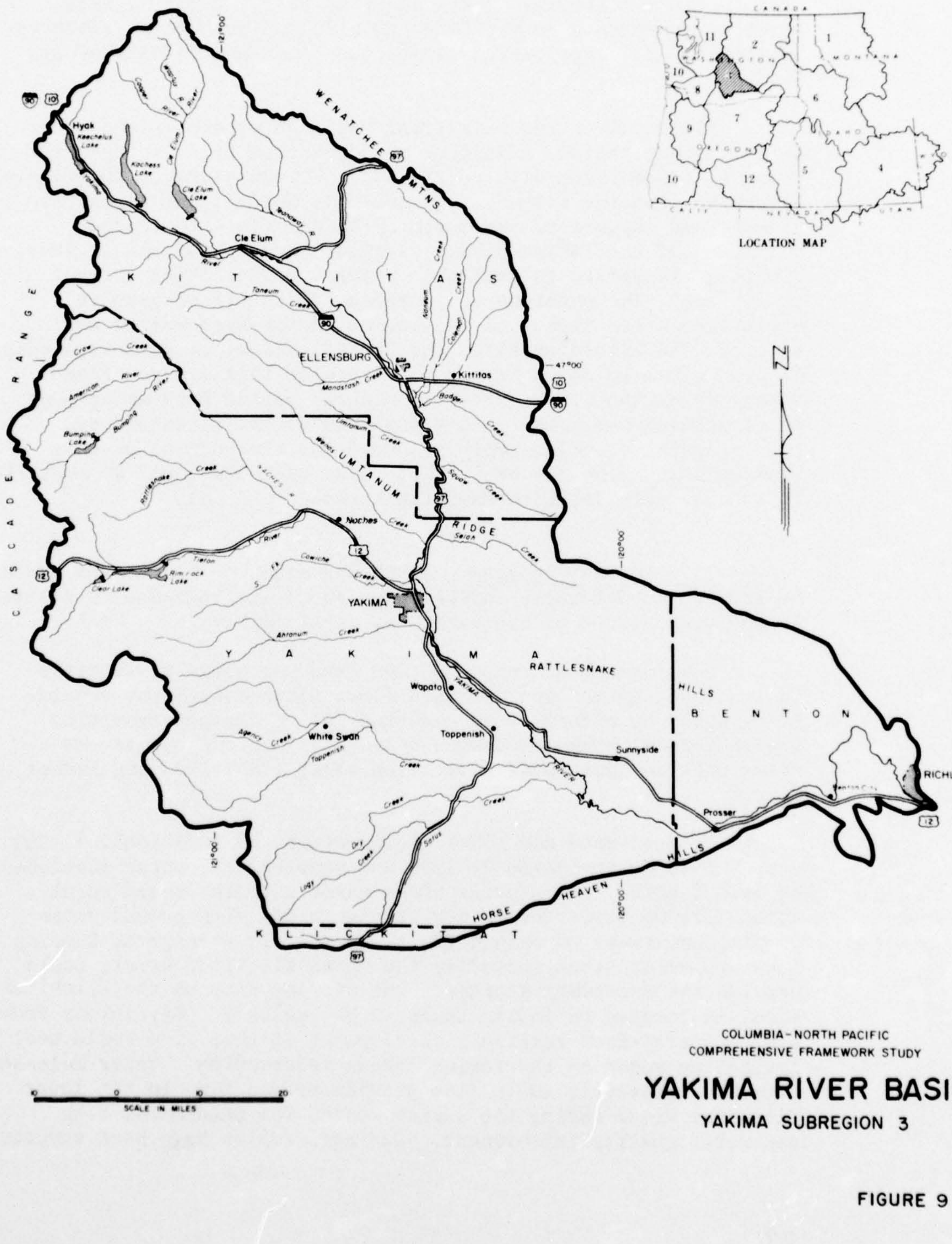
Cropland problems are mainly onfarm irrigation water management and excessive wetness. Protective measures on forest land are needed to reduce erosion. Protection could be provided to cropland, rangeland, and forested land by improved management techniques, land treatment measures, and development of small water control structures.

About 509,000 acres are presently irrigated and about 632,000 acres of potentially irrigable lands are available in the subregion. Approximately 106,000 acres of presently irrigated lands receive an inadequate water supply.

Projections indicate that municipal water use will nearly triple, industrial use will more than double, and rural-domestic use increase by 50 percent. The greatest municipal and industrial water demand is expected in the Yakima service area.

The existing highly developed upstream storage system as now authorized limits coordinated operation of the river system for all resource uses. Flow augmentation of the Yakima River is needed to abate temperature problems, enhance the fishery, and provide additional irrigation water supplies. Water supplies for development of Indian reservation lands are also needed.

During the past decade, the state has augmented the anadromous fishery by stocking. Despite these measures, runs have declined, primarily due to low river flows, poor fish passage conditions, and overfishing. Under established rights, it is impossible to increase flows for fish without new storage to capture unappropriated peak flows. Resident fish resources in the basin's streams and reservoirs are augmented by a state



COLUMBIA-NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

YAKIMA RIVER BASIN

YAKIMA SUBREGION 3

FIGURE 9

stocking program and, assuming continued stocking, there will continue to be a good fishery. Several species of big game are present with elk and deer the primary game harvested. Also, the basin, with its streams, lakes and reservoirs, forests, wild berries, mountain scenery, fish and wildlife resources, attracts recreation use. Additional recreation lands and facilities are needed.

Alternatives for satisfying basin water supply and water quality needs include adjusting the operation of existing reservoirs in combination with additional upstream storage, interbasin diversion from the Columbia, Snoqualmie, Cowlitz, or Klickitat Rivers, and capture of agricultural return flows to reduce pollution of the Yakima River. Irrigation alternatives include limiting irrigation to available water supplies under current conditions. The problems are complex and solutions involve satisfying water rights of the Yakima Indian Reservation and others. The situation calls for investigations of an interdisciplinary nature in depth beyond the scope of this study. Flood damage reduction alternatives considered varied from management to structural measures. After analysis of the alternatives, the following solutions were selected for the purpose of this framework study on the basis that these elements could be modified in future, more detailed investigations.

1970 to 1980 Program About 312 miles on 10 streams would be studied to determine whether they should be included in a state or national system of recreation or scenic rivers.

Development of comprehensive land use plans by Kittitas, Yakima, and Benton Counties with flood plain management regulations would be effective in reducing future damages resulting from potential urban expansion onto the flood plain. Levees would provide additional protection along the Yakima and Naches Rivers.

To meet food and fiber requirements, an additional 41,000 acres would be irrigated by 1980 and supplemental water furnished to 88,000 acres. To provide these water supplies would require about 722,000 acre-feet of new storage along with ground-water pumping and reuse of return flows. Reservoir storage at Bumping Lake and other sites, including the upper Klickitat River, could provide the necessary storage. One storage site on the Klickitat River is located on Indian lands in Subregion 7. Diversions from a 60,000 acre-foot reservoir development at that site would meet irrigation needs on the Yakima Indian Reservation. Water releases from this reservoir could also provide needed flow in the lower Klickitat River during the summer months for anadromous fish and water quality improvement. Current studies have been completed

or are underway by the Bureau of Indian Affairs and Bureau of Reclamation for 662,000 acre-feet of the 722,000 acre-feet needed by 1980.

Land treatment measures in 11 watersheds would remedy problems of water conservation, erosion, flooding, drainage, and forest management. These measures would also increase water yields of forested lands and provide better management of small watersheds.

Municipal and industrial water supply needs would be met from existing ground and surface-water supply sources through expanded conveyance systems. Federal-State water quality standards would be met by additional waste treatment and sewer outfall facilities installed by municipalities and industries and by increased streamflows in the Yakima River obtained by releases from Bumping Reservoir enlargement and other storage. A sewage drainage basin plan would provide guidance for water quality control and pollution abatement.

There are adequate public lands and sufficient water areas which can be used to satisfy both early action and ultimate recreation needs. Lakes and reservoirs have a potential for accommodating projected demand through expansion of existing recreation sites. Additional slack water recreational opportunities near urban centers would be provided with new reservoir storage projects such as the Tampico Reservoir just a few miles from Yakima. In view of the large increase in the boating activity, additional boat launching ramps are needed. Approximately 500 acres of land adjacent to water areas would be required by 1980 to meet swimming, boating, shoreside hiking, camping, and picnicking needs.

Landscape management and control would be provided adjacent to scenic roads; wild, scenic, and recreational rivers; around reservoirs and natural lakes; and as a buffer zone around recreation areas. Stream and lake habitat would be improved and artificial propagation facilities installed to increase resident and anadromous fish production. New fishways would be provided and existing fishways improved. Ongoing programs would be continued to provide public access at such areas as Terrace Heights Lake, Yakima Gravel Pit, and Naneum Pond. Increased streamflow from new storage releases would benefit fish production in the Naches and Yakima Rivers. Habitat on existing public land would be improved and additional lands acquired to increase wildlife production. Further stocking of game birds also is proposed as is continuation of big game winter feeding. In addition to these measures, a few species such as forest grouse and warm water game fish can support a greater harvest.

Long-Range Program   The irrigation program for the period 1980 to 2000 includes water supplies for 20,000 acres of new lands and the remaining 18,000 acres of lands needing supplemental water. Supplies would be provided from 55,000 acre-feet of new upstream storage, ground-water development, and by modifying existing storage reservoirs.

Ground water is expected to be used extensively to satisfy growth in municipal and industrial water supply demand. Development of central municipal distribution systems, primarily in the Yakima area, is expected to continue.

The level of waste treatment would be increased to the equivalent of 90 percent BOD removal. The growth in wastes would require installation of new facilities. Summer flows would be increased in the Teanaway and Yakima Rivers from additional storage to further improve water quality and fish production.

The flood plain regulations implemented during the early action period would be continued with flood control incorporated in new storage projects. A combination of improved management techniques, land treatment measures, and water control structures development would be accomplished on six small watersheds.

Additional picnicking and overnight facilities would be provided at existing recreation areas. Greenbelt areas, urban parks, swimming beaches, and boating facilities would be expanded. Studies considering preservation of unique areas and river segments not accomplished prior to 1980 would be pursued during this time period with those areas preserved where found to be in the public interest.

Fish and wildlife projects and programs would be continued.

During the 2000 to 2020 period, about 150,000 acre-feet of irrigation water supplies for 40,000 acres of new lands would be developed by an interchange of storage between Kachess and Cle Elum Reservoirs (a reverse flow tunnel), or a diversion from the Cowlitz River in Subregion 8, into the existing Tieton Reservoir and development of 100,000 acre-feet of storage on the Little Naches River above its confluence with the American River. An alternative to the Cowlitz River diversion would be diversion of water from the Columbia River and development of irrigable lands now held by the Atomic Energy Commission near Hanford. Also, cooling waters from future thermal electric powerplants at Hanford could be pumped up onto lands in the Moxee Valley. Detailed studies are required to evaluate the best possible alternative.

Flood plain management programs would be continued.

Expansion of municipal and industrial water supply facilities is projected. By 2020, about 84 percent of all municipal water users are estimated to be served from centralized systems. New wells supplying 165 MGD would be required for cities, industries, and rural-domestic users.

A continued expansion of waste treatment facilities would be necessary to keep abreast of anticipated population growth. Water related recreation and fish and wildlife programs would be continued and land treatment measures would be undertaken in seven small watersheds.

Area Plans and Programs

The composition of the framework plan is summarized in table 42 for subregions and for the area. The following narrative describes elements of the plan.

Table 42 – Framework Plan Composition, Area A

Purpose or Function	Units	Subregion 1 1970-1980	Subregion 1 1981-2000	Subregion 1 2001-2020	Subregion 1 Total	Subregion 2 1970-1980	Subregion 2 1981-2000	Subregion 2 2001-2020	Subregion 2 Total	Subregion 3 1970-1980	Subregion 3 1981-2000	Subregion 3 2001-2020	Subregion 3 Total	Area Total 1970-1980	Area Total 1981-2000	Area Total 2001-2020	Area Total Total
Water Development and Control																	
Electric Power																	
Hydro	MW	0	800	0	800	3,195	4,523	0	7,718	0	0	0	0	3,195	5,333	0	8,528
Thermal	MW	0	0	0	0	300	2,900	7,000	10,200	0	0	0	0	300	2,900	7,000	10,200
(Consumptive Use)	1,000 Ac. Ft.	0	0	0	0	23	55	117	195	0	0	0	0	23	55	117	195
Navigation																	
Locks	Number	0	0	0	0	0	3	0	3	0	0	0	0	0	3	0	3
Channels	Miles	0	0	0	0	0	57	0	57	0	0	0	0	0	57	0	57
Breakwaters	Miles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Quality Control																	
Raw Waste Production 2/	1,000 PE	368	584	699	1,651	1,029	2,098	2,909	6,036	692	650	954	2,296	2,089	3,332	4,562	9,983
Waste Removal 2/	1,000 PE	508	605	629	1,742	559	2,066	2,618	5,253	563	656	859	2,078	1,640	3,327	4,106	9,073
Municipal and Industrial Water																	
Supply	MGD	61	108	132	301	37	74	92	203	19	35	41	95	117	217	265	599
Municipal	MGD	(29)	(68)	(91)	(188)	(13)	(37)	(46)	(96)	(10)	(20)	(23)	(53)	(52)	(125)	(160)	(337)
Industrial	MGD	(28)	(33)	(33)	(94)	(21)	(30)	(37)	(88)	(6)	(12)	(15)	(33)	(55)	(75)	(85	(215)
Rural-Domestic	MGD	(4)	(7)	(8)	(19)	(3)	(7)	(9)	(19)	(3)	(3)	(3)	(9)	(10)	(17)	(20)	(47)
Diversions and Withdrawals	1,000 Ac. Ft.	68	122	149	339	42	80	104	226	22	39	46	107	132	241	299	672
Flood Control																	
Management Areas	Number	37	0	0	37	23	0	0	23	13	0	0	13	73	0	0	73
Major Stream Control (channels and levees)	Miles	20	5	15	40	7	78	0	85	61	0	0	61	88	83	15	186
Single-Purpose Storage	1,000 Ac. Ft.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation																	
New	1,000 Ac.	330	90	370	790	476	210	430	1,116	41	20	40	101	847	320	840	2,007
Supplemental	1,000 Ac.	118	50	27	195	6	31	0	37	88	18	0	106	212	99	27	338
Diversions and Withdrawals	1,000 Ac. Ft.	1,032	313	1,130	2,475	2,326	1,079	1,587	4,992	244	116	152	512	3,602	1,508	2,869 1/	7,979 1/
Multipurpose Reservoir Storage Capacity	1,000 Ac. Ft.	133	159	16	308	20	485	550	1,055	722	55	100	877	875	699	666	2,240
Water and Related Land Programs																	
Fish																	
Habitat Preservation:																	
Streams	Miles	1,300	500	350	2,150	190	50	40	280	400	110	80	590	1,890	660	470	3,020
Habitat Improvement:																	
Streams	Miles	430	570	550	1,550	115	138	151	404	88	145	140	373	633	853	841	2,327
Lakes	1,000 Ac.	13	10	13	36	19	9	14	42	2	1	2	5	34	20	29	83
Harvest:																	
Stream Access	Miles	139	91	143	373	545	259	395	1,199	357	170	258	785	1,041	520	796	2,357
Lake Access	Sites	44	27	35	106	122	58	88	268	17	8	12	37	183	93	135	411
Augmentation of Supply:																	
Hatcheries	Number	1	3	3	7	3	2	2	7	1	1	1	3	5	6	6	17
Rearing Ponds	Acres	0	0	0	0	100	150	150	400	50	25	25	100	150	175	175	500
Wildlife																	
Land Acquisition	1,000 Ac.	20	11	24	55	276	124	188	588	252	87	162	501	548	222	374	1,144
Habitat Improvement	1,000 Ac.	87	126	162	375	659	786	974	2,419	343	427	589	1,359	1,089	1,339	1,725	4,153
Improved Hunting Access	1,000 Ac.	3,000	4,000	2,900	9,900	2,700	4,000	2,500	9,200	800	1,100	700	2,600	6,500	9,100	6,100	21,700
Augmentation of Supply:																	
Game Birds	1,000 No.	10	12	18	40	62	30	45	137	66	31	48	145	138	73	111	322
Outdoor Recreation (water related)																	
Recreation Development	1,000 Rec. D.	5,300	10,600	18,600	34,500	900	6,700	11,800	19,400	1,500	3,400	6,600	11,500	7,700	20,700	37,000	65,400
Water Surface Use	Acres	8,300	40,500	71,300	120,100	2,700	16,000	29,700	48,400	1,900	12,100	24,400	38,400	12,900	68,600	125,400	206,900
Land Area (Rec. Facility Dev.)	Acres	3,500	3,600	9,000	16,100	2,100	2,600	5,400	10,100	1,400	1,400	3,100	5,900	7,000	7,600	17,500	32,100
Urban Land Acquisition	Acres	1,500	1,500	2,800	5,800	0	0	0	0	800	600	1,300	2,700	2,300	2,100	4,100	8,500
Boat Launch Areas	Lanes	20	230	398	648	12	103	197	312	10	89	180	279	42	422	775	1,239
Related Land Programs																	
Nonstructural																	
Erosion and Sediment Control	1,000 Ac.	636	817	682	2,135	631	1,684	1,186	3,501	218	339	326	883	1,485	2,840	2,194	6,519
Water Conservation	1,000 Ac.	368	92	355	815	535	206	418	1,159	46	17	39	102	949	315	812	2,076
Protection and Management	1,000 Ac.	18,275	18,196	18,006	NA	6,157	6,185	6,416	NA	1,575	1,560	1,528	NA	26,007	25,941	25,950	NA
Water Yield Improvement	1,000 Ac.	14	16	15	45	16	49	48	113	22	30	34	86	52	95	97	244
Structural																	
Drainage	1,000 Ac.	33	52	47	132	10	15	14	39	11	22	22	55	54	89	83	226
Trib. Stream Control (Flood Control)																	
Bank Stabilization	Miles	485	472	443	1,400	1,008	1,232	793	3,033	46	115	94	255	1,539	1,819	1,330	4,688
Dikes and Levees	Miles	129	131	100	360	5	3	3	11	20	14	14	48	154	148	117	419
Channel Improvement	Miles	1,926	2,433	2,375	6,734	474	521	546	1,541	240	355	330	925	2,640	3,309	3,251	9,200
Erosion Control Structures	No.	462	412	440	1,314	879	1,887	2,444	5,210	2,126	1,532	1,088	4,746	3,467	3,831	3,972	11,270
Ponds and Small Reservoirs	No.	122	270	190	582	122	266	316	704	215	303	103	621	459	839	609	1,907
Ponds and Small Reservoirs	1,000 Ac. Ft.	6	3	5	14	67	71	30	168	2	3	2	7	75	77	37	189
Coastal Zone and Estuaries																	
Estuarine Management Areas	No.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beach Stabilization	Miles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Studies																	
River Basin Studies	No.	2	--	--	2	3	--	--	3	1	--	--	1	6	--	--	6
Watersheds	No.	75	50	0	125	38	53	0	91	17	7	0	24	130	110	0	240
Special Studies:																	
Preservation of Streams	Miles	1,168	0	0	1,168	553	0	0	553	449	0	0	449	2,170	0	0	2,170
Scenic Roads	Miles	560	0	0	560	1,200	0	0	1,200	250	0	0	250	2,010	0	0	2,010
Roadless Areas	1,000 Ac.	270	0	0	270	198	0	0	198	85	0	0	85	553	0	0	553
Minimal Flows	No.	4	--	--	4	8	--	--	8	2	--	--	2	14	--	--	14
Other	No.	2	--	--	2	4	--	--	4	3	--	--	3	9	--	--	9

1/ Does not include transmittal of 565,000 acre-feet from Subregion 2 to Subregion 6.
2/ Includes municipal, industrial, and recreation uses.

Electric Power

Table 43 lists planned hydroelectric and thermal capacities.

Table 43 - Phasing of Power Installations, Area A[1/]

Subregion	1970 Existing	1970 Under Const.	1970 Total	1971-1980 Added	1971-1980 Total	1981-2000 Added	1981-2000 Total[2/]	2001-2020 Added	2001-2020 Total
				(installation in megawatts)					
Subregion 1									
Hydro	1,783	420	2,203	0	2,203	810	3,000	0	3,000
Thermal	16	0	16	0	16	0	0	0	0
Subregion 2									
Hydro	6,432	2,640	9,072	3,195	12,267	4,523	16,800	0	16,800
Thermal	800	0	800	300[3/]	1,100	2,900	4,000	7,000	11,000
Subregion 3									
Hydro	34	0	34	0	34	0	0	0	0
Thermal	0	0	0	0	0	0	0	0	0
Area A									
Hydro	8,249	3,060	11,309	3,195	14,504	5,333	19,800	0	19,800
Thermal	816	0	816	300	1,100	2,900	4,000	7,000	30,800
Total	9,065	3,060	12,125	3,495	15,604	8,200	23,800	7,000	30,800

1/ Nameplate ratings.
2/ After 1980, all existing small thermal plants would be retired, hydro capacity rounded to nearest 100 mw by subregion.
3/ Between 1970 and 1980, the existing 800 mw thermal nuclear plant would be retired and a new 1,100 mw plant constructed.

Hydroelectric Power Under the Columbia River Treaty previously described, 15,500,000 acre-feet of storage are being developed in Canada for power use and nearly 5 million acre-feet at Libby Dam for power and other uses. As a result of this storage and other developments, construction of additional peaking capacity is underway or planned at many Columbia River plants.

Table 44 shows planned addition to existing power projects in the area. The increase at Wanapum, Rock Island, Chief Joseph, and Grand Coulee is for use of regulated flow from Canadian storage and for peaking purposes. At most of these plants, structural provisions have been made for the future addition of the units listed. At others, only the space has been provided.

Table 44 - Planned Additions to Hydroelectric Resources, Area A

Project	Additional Capacity 1970-1980	1981-2000	2001-2020
		(megawatts)	
Subregion 1			
Libby	0	420	0
Libby Reregulating	0	44	0
Boundary	0	275	0
Noxon Rapids	0	71	0
Total	0	810	0
Subregion 2			
Wanapum	0	499	
Rock Island	350	0	0
Chief Joseph	1,045	0	0
Grand Coulee	1,800	3,600	0
Grand Coulee Pumping	0	200	0
Chelan	0	224	0
Total	3,195	4,523	0
Subregion 3	0	0	0
Area A	3,195	5,333	0

Thermal Power The Washington Public Power Supply System operates a nuclear thermal plant with a nameplate rating of 800,000 KW along the Columbia about 23 miles below Priest Rapids Dam. This plant is expected to be phased out by 1980.

The upper Columbia River area has sites for thermal power installations that would have minimumal environmental impact. Accordingly, the regional power plan includes the thermal capacities shown with water requirements in table 45. This plan is essentially the same as the alternative shown in Appendix XV, Electric Power, for the conditions of regionwide minimum hydro development and minimum thermal installations west of the Cascade Range consistent with existing transmission corridors.

Table 45 - Planned Thermal Power and Water Requirements, Area A

Subregion	Thermal Installations 1980	2000	2020	Annual Water Requirements 1980	2000	2020
		(megawatts)			(1,000 ac-ft)	
1	0	0	0	0	0	0
2	1,100	4,000	11,000	23	78	195
3	0	0	0	0	0	0
Area A	1,100	4,000	11,000	23	78	195

Power from Pumped Storage   With the region's base load being gradually shifted to thermal generation and existing hydroplants being expanded to their potential capacity, pumped-storage is becoming an attractive source of peaking capacity. In the upper Columbia River area, the first pumped-storage generation in the region is now under construction at the Grand Coulee Project. Two 48,500 KW units are scheduled for operation in 1973, and four more are planned for a total of 291,000 KW. These units will operate on the head between Banks Lake and Lake Roosevelt.

Several other sites appear attractive, including a potential development between Lake Roosevelt and Sherman Creek which would have a 1,100-foot head and the Antilon Lake-Lake Chelan Project. The latter is currently under study by Chelan County PUD and tentatively would contain reversible units with a total capacity of 1000 MW. Operation would be on a daily/weekly cycle basis (and reserve storage would be provided to enable the plant to sustain generation for periods somewhat longer than that required for normal weekly operation). Because of the large capacity available in the lower reservoir (Lake Chelan), only minimal fluctuations in the level of the lake would be experienced.

Many other sites capable of weekly operation exist in this area. The Corps of Engineers is presently engaged in inventorying these sites for use in future planning. The greatest need for pumped-storage generation is near the major load centers, west of the Cascade Range; consequently, pumped-storage that would operate on a weekly cycle is not a major element in framework plans developed for the upper Columbia River area.

Seasonal pumped-storage may show considerable promise in this area. Operated on a seasonal basis, a project could store some of the surplus water of the mainstem river during times of peak flow and release water during times of minimum flow. These large reservoirs could also be designed for multipurpose use, incorporating irrigation storage, flood control, recreation, etc.

Summary   By 2020, the upper Columbia River area would have additional capacity of about 8,500 MW of hydroelectric power and 10,200 MW from thermal sources. Additional hydro capacity of 1,000 MW or more each may also be available from new pumped storage developments. The operation of these power installations would be dependent on the results of continuing detailed regional power studies.

Navigation

Physical navigation development in the first time period is limited to installation of a boat transfer facility at Albeni Falls Dam on the Pend Oreille River which would pass pleasure boats around the dam. Existing ferry, log towing and pleasure boating activities and related facilities would be continued; however, log towing is expected to decline on Lakes Chelan and Franklin D. Roosevelt. During the 1980-2000 time period, the framework plan includes the alternative which provides for a 125-mile extension of the navigation on the Columbia River from the McNary pool to Wenatchee. This includes a channel 250 feet wide from McNary Dam pool, river mile 340, to Priest Rapids Dam, river mile 397, and locks 86 feet wide; 675 feet long with 15 feet of depth over the sills at Priest Rapids, Wanapum, and Rock Island Dams. Acceptance of this alternative would be dependent on a detailed interdisciplinary study of the Columbia River. Also in this time period would be the improvement of the channel at the mouth of the St. Joe River for navigation by stabilizing eroding banks.

Water Quality Control

This study has assumed that the standards set by the states and approved by the Federal Government would be met to the extent that waste treatment would achieve 85 percent organic removal by 1980. New or expanded waste treatment plants with adequate facilities to reach a treatment level of 90 percent removal by 2000 and 2020 are included in the plan. Table 46 illustrates the residual wastes projected for the area on the basis of the above treatment.

Facilities are required for advanced treatment in critical areas to remove salts, residual organic materials, and nutrients, in addition to the measures previously set forth.

The most damaging discharge to streams are mining wastes in the Butte-Anaconda, Metaline Falls, and Coeur d'Alene areas. The water quality standards call for treatment of wastes from the Metaline Falls and Coeur d'Alene areas. However, in the Butte-Anaconda area, the primary metals operations still discharge partially untreated wastes to Silver Bow Creek which is classified by Montana State law as an industrial waterway.

The problem can only be eliminated by the reclassification of Silver Bow Creek by the State of Montana to prohibit untreated wastes from being discharged into the stream. Another problem associated with mining is the concentration of heavy metals in

Table 46 - Projected Raw Waste Production and Residual Discharge with Planned Treatment, Area A

	1970		1980		2000		2020	
	Raw	Disch.	Raw	Disch.	Raw	Disch.	Raw	Disch.
				(1,000 p.e.)				
Subregion 1								
Municipal	497	134	621	93	886	88	1,204	120
Industrial	591	225	792	119	975	97	1,105	110
Recreation	119	17	162	24	298	30	549	55
Total	1,207	376	1,575	236	2,159	215	2,858	285
Subregion 2								
Municipal	193	39	242	36	363	36	495	50
Industrial	2,253	23	3,206	481	5,097	510	7,717	772
Recreation	76	11	103	16	189	19	346	34
Total	2,522	73	3,551	533	5,649	565	8,558	856
Subregion 3								
Municipal	137	34	165	25	237	24	331	33
Industrial	553	44	1,202	180	1,732	173	2,502	250
Recreation	42	7	57	9	105	11	195	20
Total	732	85	1,424	214	2,074	208	3,028	303
Area A								
Municipal	827	207	1,028	154	1,486	148	2,030	203
Industrial	3,397	292	5,200	780	7,804	780	11,324	1,132
Recreation	237	35	322	49	592	60	1,090	109
Total	4,461	534	6,550	983	9,882	988	14,444	1,444

Source: Appendix XII, Water Quality and Pollution Control.

mine washings; these are extremely toxic to all forms of life. Seepage from old ponds and tailings is a continuing water quality problem which will remain for years after a mine has been closed. Inadequate control of these wastes has an adverse effect on water quality. Every effort should be made to locate these sources and seal them off or provide other measures to prevent the toxic seepages from reaching the waterways.

The waste discharge of the Spokane service area with 85 percent treatment would require a flow in the Spokane River of 2,950 cfs in 2020, a situation which will not be met approximately 44 percent of the time; and, at the 95 percent level of treatment, the minimum flow of 1,500 cfs would be deficient about 5 percent of the time. Because of the deficient streamflows and the algal blooms in Long Lake, higher degrees of treatment to remove the maximum amount of organics and nutrients before discharge into the Spokane River are proposed in addition to augmentation of low water flows.

The mineral content of Crab Creek below Potholes Reservoir, where dissolved solids range from 300-350 mg/l, is significantly increased by ground-water inflow and agricultural return flows.

At the confluence of Crab Creek with the Columbia River, the mean total dissolved solids concentration is about 750 mg/l. Dissolved oxygen remains at a relatively high level (over 6.5 mg/l) through this reach of the creek. Coliform densities as high as 46,000/100 ml have been reported in lower Crab Creek. Excessive algal growth has interfered with recreational and fisheries uses of Moses Lake. These conditions appear to result from nutrient inflow from ground water, domestic wastes, and agricultural return flows. Abatement measures include land treatment controls and management practices to alleviate this problem. The plan includes storage in the 1980-2000 period to augment flows in lower Crab Creek and thus improve the water quality.

Low summer flows with high temperatures in the lower reaches of the Yakima River are detrimental to fish passage; high nutrient concentrations stimulate excessive growths of aquatic blooms, and high coliform densities prohibit safe, water-contact recreation activities in the Yakima River from Ellensburg to the mouth. Waste treatment included in the framework plan would aid in solving the organic and bacterial problems. Reallocation of existing storage and also new storage are needed to provide for improved water quality as well as other uses. Some additional storage would be provided by 1980, and the remaining storage requirements by 2000 and 2020.

Rural wastes will be of major significance in a number of areas and are estimated to reach approximately 328,000 P.E. in 1980, and to remain at about the same level through 2020. The disposal of rural wastes to septic tanks and drain fields will continue to represent a possible hazard to the groundwater aquifer of the Spokane area, as well as a few other more localized areas. In the lake areas, particularly the Spokane area, and Coeur d'Alene, Priest, Pend Oreille, and Flathead Lakes, it is recommended that interception of wastes from summer home developments and collection of sewage from houseboats for disposal to an approved central sewage treatment facility be provided. Sewage disposal systems adequate to cope with weekend loads from use by thousands of people will be needed in these and other recreation areas. Measures to meet these needs include facilities for collection and pickup of litter and garbage, and restrictions on motor boats on heavily used lakes to keep oil and gas pollution at a minimum are recommended. Total wastes from recreation sources are projected to reach about 322,000 P.E. in 1980, 592,000 in 2000, and 1,090,000 in 2020.

Nutrients from runoff and agricultural return flows are a problem, but tests indicate it is not serious unless the water also carries sediment. Salt is not a problem. Extensive programs for land treatment and management, along with water conservation

practices, are planned to reduce runoff, erosion, and return flow. It is expected that these programs will more than offset potential problems associated with more intensive land use and increased irrigation.

The animal population in the area represents a potential large source of organic wastes. The population equivalent of these wastes is estimated to reach 11.9 million in 1980, 15.9 million in 2000, and 20.8 million in 2020. To prevent animal wastes from possibly entering the water courses, fences and simple retaining structures between the animal habitat and watercourses are recommended to prevent bank erosion and to limit direct surface drainage so that wastes may decompose through soil processes. At some places, it may be preferable to collect the waste from cattle-holding facilities for treatment or distribution to the land as a fertilizer.

As waste treatment does not provide an economic solution for complete removal of contaminants or cannot be applied to noncollectible wastes, a certain amount of streamflow is necessary for dilution and assimilation of residual wastes reaching the streams. The minimum flow requirement is related to a number of factors, including the strength of deoxygenation capacity of the wastes, and the temperature, reaeration capacity, elevation, and minimum allowable dissolved oxygen for the stream. Minimum instream flows are required for fisheries and esthetic values. Such flow requirements would probably be sufficient to assimilate any wastes that may reach the streams. Studies to establish minimum flow requirements are included in the listing of required future studies.

Municipal and Industrial Water Supply

Water resources generally are available to meet the demands of municipal, industrial, and rural-domestic water supply. However, local difficulties in obtaining water undoubtedly will develop. As municipal systems are expanded and replaced in the future, communities will have to shift to complete treatment of surface-water supplies. Where quality of ground water cannot be controlled, treatment will also be required. The framework plan includes measures for conveyance to the point of distribution and treatment as required to bring the quality to interstate standards. Table 47 shows the area's projected water supply needs by subregion and time period.

Table 47 - Planned Municipal and Industrial Water Supply, Area A

Sub-region	Water Use	1970	1980	2000	2020
			(mgd)		
1	Municipal	131.1	159.9	228.3	319.0
	Butte-Anaconda Service Area	(15.7)	(16.6)	(16.4)	(15.7)
	Missoula Service Area	(11.1)	(13.4)	(19.2)	(25.7)
	Spokane Service Area	(72.0)	(89.4)	(141.0)	(205.0)
	Other	(32.3)	(40.5)	(51.7)	(72.6)
	Industrial	153.3	181.0	214.4	247.5
	Rural-Domestic	24.9	28.9	35.8	44.6
	Total	309.3	369.8	478.5	611.1
2	Municipal	49.0	62.2	98.6	145.2
	Tri-Cities Service Area	(22.5)	(28.5)	(46.0)	(66.2)
	Other	(26.5)	(33.7)	(52.6)	(79.0)
	Industrial	56.8	78.4	107.7	144.5
	Rural-Domestic	18.7	21.9	29.0	38.0
	Total	124.5	162.5	235.3	327.7
3	Municipal	28.7	38.7	59.1	81.9
	Yakima Service Area	(16.7)	(25.0)	(41.0)	(62.9)
	Other	(12.0)	(13.7)	(18.1)	(19.0)
	Industrial	26.4	32.2	44.1	58.6
	Rural-Domestic	17.9	21.2	24.4	27.0
	Total	73.0	92.1	127.6	167.5
Area A	Municipal	208.8	260.8	386.0	546.1
	Industrial	236.5	291.6	366.2	450.6
	Rural-Domestic	61.5	72.0	89.2	109.6
	Total	506.8	624.4	841.4	1,106.3

Source: Appendix XI, Municipal & Industrial Water Supply.

Municipal In Subregion 1, most surface supplies are from headwater areas and are of sufficient quality that treatment beyond chlorination will be minimal. For several areas that use ground-water supplies, bacterial contamination will continue to be a problem, particularly where septic tank systems are used. Potential problems facing the suburban areas of Spokane and Missoula are the contamination of individual and municipal ground-water supplies by individual subsurface disposal of domestic wastes. The obvious solution to protecting the aquifers is to provide the areas with sanitary sewers and water distribution systems.

Ground water is utilized extensively for municipal water supplies in Subregion 2. The Columbia Basin Project has greatly increased the amount and level of ground water in this area. The quality is generally adequate for all municipal purposes with minimal treatment; however, increased pumping, coupled with poor land and water-use practices, tends to deteriorate the quality of ground water. Ground waters in the vicinity of Moses Lake contain concentrations of nitrogen greater than the limits (10 mg/l as nitrogen) recommended by the Public Health Service Drinking Water Standards. Higher levels of treatment will be required as water needs increase and as the quality of the ground water deteriorates. The quality of the ground water can be controlled to some degree by improving agricultural practices.

Except for the headwaters, the quality of surface waters in Subregion 3 is generally undesirable for municipal water supplies without complete treatment. Ground water is widely used for municipal supplies but, as the needs increase, some of the well fields may experience pumping difficulties, and the water quality may deteriorate. The problem in most cases can be avoided by optimum spacing of wells and modification of the pumping schedules. On occasions, it will be necessary to resort to surface waters to meet the increased requirements. Yakima has recently installed a treatment plant on the Naches River which will replace its existing ground-water supply system.

Industrial Sufficient quantities of ground and surface water are available in the area to meet the projected industrial water requirements, and no problems are anticipated. However, there may be isolated situations requiring storage to meet peak demands. Treatment may be required in some instances to meet industrial requirements.

Rural-Domestic Most rural-domestic supplies will be from ground water, and no serious quality problems are anticipated; however, treatment will be required if the quality should be below acceptable standards.

Flood Control

Damages from flooding on both major and minor streams are projected to increase from the present level of $9,395,000 annually to $31,257,000 by 2020 under present levels of protection and current trends of development. Flood plain regulation, including zoning and flood proofing, and improved early warning systems would reduce the impact of floods without controlling the

flood waters. Structural measures and land treatment would reduce the extent and frequency of flooding.

Nonstructural Measures Flood plain information studies are proposed to facilitate flood plain management which would reduce future flood damages in the following areas and counties:

Clark Fork River	Powell, Granite, Missoula, Mineral, Sanders, Montana
Bitterroot River	Ravalli, Montana
Flathead River	Flathead, Lake, Montana
Pend Oreille River	Bonner, Idaho; Pend Oreille, Washington
Kootenai River	Lincoln, Montana; Boundary, Idaho
Spokane-St. Joe River	Shoshone, Kootenai, Benewah, Idaho; Spokane, Washington
Big Bend Area	Lincoln, Grant, Franklin, Washington
Okanogan-Methow River	Okanogan, Washington
Wenatchee River	Chelan, Washington
Colville River	Stevens, Washington
Yakima River	Kittitas, Yakima, Washington

These studies, prepared by the Corps of Engineers, Soil Conservation Service, or Geological Survey, provide data for planning appropriate regulations.

Flood proofing of existing and future structures in the various flood plains should be accomplished to the extent practicable. The ongoing Federal-State programs of flood forecasting and evaluation would be continued as these measures assist in reducing losses.

Structural Measures Multiple-purpose storage described under Reservoir Storage would be operated for flood control. A total of 186 miles of levees and channels listed in table 48 are included in the framework plan. These local protection works would supplement the protection afforded by storage where it exists and would be subject to change to become compatible with any future additional storage.

Table 48 - Planned Local Flood Protective Works, Area A

Stream	Location	Type of Work
	1970-1980	
Blackfoot River	Lincoln, Montana	Levee
Flathead River	Kalispell, Montana	Levees
Flathead River	Flathead Lake	Improve lake outlet
Swan River	Swan Lake	Improve lake outlet
Calispell Creek	At Pend Oreille R.	Pumping plant
Pine Creek	Pinehurst & Pine Creek, Id.	Improve existing levees
Cottonwood Creek	Deer Lodge	Diversion channel
Placer Creek	Wallace, Idaho	Channel improvement
Canyons 1 and 2	Wenatchee, Washington	Channel enlargement
Crab Creek	Odessa	Channel improvement
Dry Creek	Ephrata	Channel improvement
Yakima River	South Cle Elum	Levee-right bank
Yakima River	Ellensburg	Levees
Yakima River	Parker to Granger	Levees-right bank
Yakima River	Near Selah	Levees-right bank
Yakima River	Donald-Buena area	Levees
Naches River	Naches Valley	Levees-both banks
	1980-2000	
S. Fork Coeur d'Alene River	Smelterville, Kellogg	Improve existing levees
Okanogan River	Oroville	Levee
Okanogan River	Riverside	Levees-right bank
Okanogan River	Omak	Levees-both banks
Okanogan River	Okanogan	Levee-right bank
Wenatchee River	Below Leavenworth	Levees
Esquatzel Coulee	Mesa	Levees
Colville River	Lower 48 miles	Channel improvement
	2000-2020	
Clark Fork	Missoula, Montana	Levee and floodwall
Pend Oreille River	Near Cusick, Washington	Improve existing levees
St. Regis River	St. Regis, Montana	Improve existing levee
St. Regis River	Saltese, Montana	Levee

The local protection works in table 48 are single-purpose flood control measures and would provide, as a minimum, protection against floods of 100-year frequency in urban areas and 25-year frequency in rural areas. A higher degree of protection should be provided where justified. Flood damage problems are subject to continuing investigation which could result in the addition or deletion of measures, or changes from one time period to another.

In addition to the above improvements, flooding will also be alleviated on many tributary watersheds by land treatment measures and small ponds or reservoirs. These measures and practices are given in the "Related Land Programs" section.

Irrigation

Projections indicate that 3,850,000 acres of land need to be irrigated by 2020, an increase of 2,007,000 acres in the next 50 years. Approximately 25 percent of these lands are located in Montana, 55 percent in the Big Bend area of central Washington, and the remaining 20 percent in northern Idaho and scattered locations in Washington. In addition to the new lands, 338,000 acres of presently irrigated lands in need of supplemental water supplies would be furnished a full supply.

Irrigation diversions, as shown in table 49, indicate an increase of nearly 8 million acre-feet is required to meet the new and supplemental water needs; about 0.5 million acre-feet are projected to come from ground-water sources, and 7.5 million acre-feet from surface water. New storage of 2.24 million acre-feet would be necessary, including 60,000 acre-feet of storage in the adjacent Klickitat River drainage to be diverted into the Yakima Basin.

Approximately 25 percent of the irrigation development is expected to be through private initiative, both individually and by small groups, and the remainder through Federal and federally assisted projects. Table 49 shows the planned irrigation development in terms of land and water.

In the Clark Fork and Kootenai Basins, nearly all irrigation development would be confined to the narrow river valleys where direct diversion facilities would provide the water supplies. In the Bitterroot River Basin, irrigation is presently quite extensive, but about 43,000 acres of the 119,000 irrigated acres receive an inadequate water supply. To achieve adequate water supplies for the projected 21,000 acres of new lands and the lands needing supplemental supplies, new storage would be necessary along with exchange of water rights between irrigation

districts, rehabilitation of existing canals and ditches, and the conversion of ditches to pressure pipe systems.

In the Flathead River Basin, the projected irrigated acreages are expected to be served primarily by pumping from the Flathead River and tributaries, Flathead Lake, and ground water with small reservoirs providing some supplemental supplies.

Acreages projected for irrigation in the Lower Clark Fork, Kootenai River, and Pend Oreille River basins would receive their water supplies by direct diversion from streams and ground water. About 40,000 acres would be irrigated from the latter source.

In the Spokane River Basin, about 190,000 acres are expected to be irrigated. In the Clayton-Deer Park area, about 91,000 acres could be developed by diversion from the Spokane River which would require upstream or offstream storage of 150,000 acre-feet.

In central Washington, 1,116,000 new acres are projected for development by 2020 with 95 percent of these lands projected for the Big Bend area. Included in the Big Bend area total are 560,000 acres of the Columbia Basin Project remaining to be developed. The water supplies for the remaining 556,000 acres are available in Franklin D. Roosevelt Lake. Significant pump lifts, canals, pipelines, and offstream storage would be necessary to provide water supplies to the farms. Some 1,035,000 acre-feet of offstream storage are projected although this could be modified extensively with further analysis of the pump-storage potential adjacent to Roosevelt and Banks Lakes.

In the Okanogan River Basin, about 20,000 acre-feet of upstream storage are required in the first time period to irrigate 13,000 acres. Further storage would involve Canada and require agreements beyond the scope of this report; therefore, the plan does not include additional storage. Accordingly, the remaining lands to be irrigated, which amount to 23,000 acres and are in scattered locations along tributary streams, are to be supplied from surface and ground-water sources. Diversions would be about equally divided between ground and surface sources.

The Yakima River Basin is extensively irrigated at the present with water supplies provided from ground water, natural flows, and about 1,100,000 acre-feet of storage. To meet projected needs, 877,000 acre-feet of new storage would be necessary, including 60,000 acre-feet located in Subregion 7 requiring interbasin diversion. In addition to the reservoir storage, ground-water sources would provide water supplies for 18,000 acres.

Table 49 - Planned Irrigation Development, Diversions, and Depletions, Area A
Columbia-North Pacific Region

Location or Basin	1970-1980				1980-2000				2000-2020				1970-2020			
	Acreage		Diver-sion	Deple-tion	Acreage		Diver-sion	Deple-tion	Acreage		Diver-sion	Deple-tion	Acreage		Diver-sion	Deple-tion
	New	Suppl.			New	Suppl.			New	Suppl.			New	Suppl.		
	(1,000 ac)		(1,000 ac-ft)		(1,000 ac)		(1,000 ac-ft)		(1,000 ac)		(1,000 ac-ft)		(1,000 ac)		(1,000 ac-ft)	
Subregion 1																
Upper Clark Fork	56	18	168	91	2	0	12	5	15	0	53	34	73	18	233	130
Bitterroot	19	43	57	31	1	0	13	6	1	0	13	7	21	43	83	44
Flathead	100	50	300	162	27	50	83	42	150	27	437	288	277	127	820	492
Lower Clark Fork	32	4	95	51	3	0	9	4	60	0	175	115	95	4	280	170
Kootenai	25	0	75	40	14	0	43	21	46	0	133	88	85	0	251	149
Pend Oreille	16	1	34	21	9	0	19	10	24	0	53	36	49	1	106	67
Spokane	82	2	302	171	34	0	134	72	74	0	266	182	190	2	702	425
Total	330	118	1,032	567	90	50	313	160	370	27	1,130	750	790	195	2,475	1,477
Subregion 2																
Big Bend Subarea	460	0	2,254	1,008	187	31	976	191	410	0	1,517	723	1,057	31	4,747	1,922
Ferry-Stevens	3	1	12	7	10	0	41	22	10	0	34	23	23	1	87	52
Wenatchee, Chelan, and Entiat	0	5	0	0	0	0	0	0	0	0	0	0	0	5	0	0
Methow Okanogan	13	0	60	34	13	0	62	33	10	0	36	24	36	0	158	91
Total	476	6	2,326	1,049	210	31	1,079	246	430	0	1,587	770	1,116	37	4,992	2,065
Subregion 3																
Yakima	41	88	244	134	20	18	116	59	40	0	152	102	101	106	512	295
Area A	847	212	3,602	1,750	320	99	1,508	465	840	27	2,869	1,622	2,007	338	7,979	3,837
Planned Diversion to Snake River Drainage											565	565			565	565
Total Diversion and Depletion											3,434	2,187			8,544	4,402

Reservoir Storage

Reservoir storage included in the framework plan serves general water resource purposes as shown in table 50.

Table 50 - Planned Reservoir Storage, Area A

	Increments of Storage 1980	2000	2020	Total	Purpose[1/]
		(1,000 ac-ft)			
Subregion 1					
Upper Clark Fork	100	0	11	111	F, I, R
Bitterroot River	33	0	0	33	F, FC, I, R
Flathead River	0	9	0	9	F, I, R
Spokane River	0	150	5	155	FC, I, R, WQ
Total	133	159	16	308	
Subregion 2					
Big Bend	0	485	550	1,035	F, FC, I, R, WQ
Methow-Okanogan	20	0	0	20	F, I, R
Total	20	485	550	1,055	
Subregion 3					
Yakima River	722	55	100	877	F, FC, I, R, WQ
Area A	875	699	666	2,240	

1/ F-Fish; FC-Flood Control; I-Irrigation; R-Recreation; WQ-Water Quality.

In the upper Clark Fork Basin, storage for irrigation and other incidental uses would be from reservoirs of 2,000 to 6,000 acre-feet capacity in small tributary watersheds, and one of approximately 60,000 acre-feet capacity.

Storage in the Bitterroot Basin could be obtained by enlarging existing reservoirs at Lake Como, Burnt Fork, and West Fork. This storage would supply irrigation; augment low flows for water quality, fish and wildlife, and recreation; aid in flood control; and improve the reservoirs for recreation use.

About 9,000 acre-feet of storage would be required in the Flathead Basin to assure a full supply of irrigation water. This would be available from small watershed reservoirs.

A reservoir on the Coeur d'Alene River in the Spokane Basin to provide recreation, augment low flows for esthetics, irrigation, water quality, and fisheries, and control low flows for downstream flood protection would be constructed contingent on the findings of further studies.

Storage on Crab Creek would provide irrigation water supply; flood protection; flow augmentation for esthetics, fish and wildlife, and water quality; and reservoir recreation. Additional offstream storage in the Big Bend area would permit a greater flexibility to future irrigation development of this area and, at the same time, provide fish, wildlife, and recreational values. Opportunity exists for utilizing some of this storage in conjunction with potential pump-storage operation at Banks and Roosevelt Lakes, and/or thermal power generation. These possibilities must be examined in greater detail before decisions can be made as to the best plan.

Storage in the Okanogan River Basin would provide irrigation, water supply, and reservoir recreation and fishing opportunities. Any additional storage would be dependent on the results of joint studies with Canada.

Multiple use of the 1.07 million acre-feet of existing storage space and provision of 877,000 acre-feet of additional storage in the Yakima Basin would provide additional irrigation water; flow augmentation for fish, water quality, and enhancement; and, by the geographic location of the reservoirs, provide flood control. The final location and scoping of storage is dependent on a plan to be selected by more detailed interdisciplinary studies.

Preservation and Enhancement of Natural Environment

Preservation of Rivers The Priest, Moyie, and St. Joe Rivers in Idaho, and the North Fork and portions of the South and Middle Forks of the Flathead River in Montana, have been selected by Congress as potential inclusions to the national systems of wild and scenic rivers. Also, the Blackfoot River in Montana, the Wenatchee River in Washington, and the lower 57 miles of the upper Columbia River have been designated for study by the Secretaries of Agriculture and Interior as potential additions to the national system. Many other streams or segments have significant recreational values. Table 51 lists systems or stream segments worthy of study to determine whether they should be a part of the national or a state system of recreation streams. Many of the segments listed are under consideration for development to meet other needs. Also, many of these segments have been identified as having fish habitat of sufficient value to warrant limiting development (see table 52, Preservation of Fish Habitat). Proposed followup interdisciplinary investigations would evaluate the best ultimate use of these resources in the total public interest.

Table 51 - Potential Recreation Streams, Area A

Description	Miles	Acres at 320/mile
Subregion 1		
Rivers designated for study in the Wild and Scenic Rivers Act, P.L. 90-542 Sec. 5(a)		
Priest River - the entire main stem.	68	21,760
Moyie River - Canadian border to its confluence with the Kootenai River.	24	7,680
St. Joe River - the entire main stem.	132	42,240
Flathead River 1/		
North Fork - Canadian border to its confluence with the Middle Fork.	59	18,880
Middle Fork - origin to confluence with South Fork.	91	29,120
South Fork - origin to Hungry Horse Reservoir.	60	19,200
Rivers selected for 5(d) Status under the Wild and Scenic Rivers Act, P.L. 90-542		
Blackfoot - segment from Landers Fork to Milltown Dam.	100	32,000
Other rivers selected for study		
Coeur d'Alene River - origin to Enaville. 1/	65	20,800
Spokane River - origin to its confluence with the Columbia River.	51	16,320
Stillwater River - north city limits of Kalispell to upper Stillwater Lake.	42	13,440
Swan River - origin to Swan Lake.	47	15,040
Rock Creek - origin to confluence with Clark Fork.	51	16,320
St. Maries River - origin to confluence with St. Joe River.	45	14,400
Middle Fork - origin to confluence with West Fork.	9	2,880
West Fork - origin to confluence with Middle Fork.	5	1,600
Kootenai River - Libby Dam to Canadian border.	65	20,800
Bitterroot River - junction of the West and East Forks to its confluence with the Clark Fork.	80	25,600
Bull River - confluence of Smith and Middle Forks to Cabinet Gorge Reservoir	27	8,640

1/ All or a portion of this stream is recommended to be considered for fish habitat preservation.

Table 51 - Continued

Description	Miles	Acres at 320/mile
Thompson River - outlet of Lower Thompson Lake to confluence with Clark Fork River.	44	14,080
Pend Oreille - Pend Oreille Lake to Canadian border.	103	32,960
Total Federal Study Rivers Section 5(a)	434	138,880
Total Section 5(d)	100	32,000
Total Other Rivers	634	202,880
	1,168 1/	373,760 1/
Subregion 2		
Rivers selected for 5(d) Status under the Wild and Scenic Rivers Act, P.L. 90-542		
Columbia River - From Priest Rapids to McNary Pool. 2/	57	18,240
Wenatchee River - entire river including Lake Wenatchee. 3/	59	18,880
White River - from origin to Lake Wenatchee. 3/	27	8,640
Chiwawa River - from origin to its confluence with the Wenatchee River.	33	10,560
Other rivers selected for study		
Methow River - from origin to confluence with the Columbia River. 3/	83	26,560
West Fork Methow River - from its origin to its confluence with the Methow River. 3/	14	4,480
Twisp River - from its origin to its confluence with the Methow River.	28	8,960
Sanpoil River - from origin to confluence with the Columbia River.	64	20,480
West Fork Sanpoil River - from origin to confluence with the Sanpoil River.	21	6,720
Little Wenatchee River - from its origin to Lake Wenatchee.	17	5,440
Entiat River - from origin to confluence with the Columbia River.	48	15,360

1/ Impoundments not included.
2/ A detailed interdisciplinary study is recommended to determine the best plan for use on this reach of the Columbia River.
3/ See footnote 1, page 209.

Table 51 - Continued

Description	Miles	Acres at 320/mile
Okanogan River - Osoyoos Lake to its confluence with the Columbia River	75	24,000
Similkameen River - from Canadian border to its confluence with the Okanogan River.	27	8,640
Total Section 5(d)	176	56,320
Total Other Rivers	377	120,640
Subregion 2	553 1/	176,960 1/
Subregion 3		
Other rivers selected for study		
Yakima River - from its source to its confluence with the Columbia River. 2/	210	67,000
Naches River - from origin to confluence with Yakima River. 2/	45	14,400
American River - from origin to confluence with Bumping River. 2/	25	8,000
Bumping River - from origin to confluence with Naches River. 2/	25	8,000
Tieton River - from Tieton Reservoir to confluence with Naches River. 2/	21	6,720
North Fork Tieton River - from origin to Rimrock Lake. 2/	15	4,800
South Fork Tieton River - from origin to Rimrock Lake. 2/	21	6,720
Teanaway River - from origin to confluence with the Yakima River. 2/	12	3,840
North Fork Teanaway - from origin to junction with Teanaway River. 2/	19	6,080
Middle Fork Teanaway River to junction with West Fork Teanaway River. 2/	15	4,800
West Fork Teanaway River - to junction with Middle Fork Teanaway River. 2/	15	4,800
Cle Elum River - from origin to confluence with Yakima River. 2/	26	8,320
Subregion 3	449	143,680
Area A	2,170 1/	694,400 1/

1/ Impoundments not included.
2/ See footnote 1, page 209.

Minimum Flows for Environmental Values The natural environmental values of a stream depend both on the character of the shoreline and its flow characteristics. When the streamflows decrease below reasonable levels, streams can be unattractive and lose much of their esthetic values. In addition to the esthetic aspects, minimum streamflows are required for fisheries and for water quality. Studies of all streams, considering the above, are required to establish withdrawal limits and determine low flow augmentation requirements.

Landscape Management and Control Landscape management and control measures adjacent to scenic roads; wild, scenic, and recreational rivers; reservoirs; and natural lakes and as buffer zones around recreational areas should be undertaken. Title in fee is not required for all lands, as the objective of this program is to provide a natural background setting to add to the enjoyment of visitors.

Wilderness and Primitive Areas Large acreages are devoted to a variety of recreation and associated activities. Examples include Glacier National Park and the North Cascades National Park Complex, Bob Marshall and Paysaten Wildernesses, Ginko Petrified Forest, and Columbia National Wildlife Refuge. Projections indicate that wilderness and primitive areas may require expansion. Although data are presently not available to accurately determine future needs, about 550,000 acres of roadless area have been identified as potential additions to a state or Federal wilderness system. The plan includes the provision to complete these studies during the early action period.

Historic and Unique Areas Historical sites are scarce due in part to the closing of much of eastern Washington to settlement during the Indian wars. However, Fort Colville, Fort Okanogan, Fort Simcoe, and Fort Spokane, plus the mining areas of Idaho and Montana, are points of interest. In the upper Columbia River area, the archeological and historical sites which should be preserved include campsites and the trail route of the Lewis and Clark expedition, old mining camps, ghost towns, Indian camps, and battlegrounds.

Guided tour areas such as historic interpretive trails or roads, nature trails, and general areas of interest should be established. Organized tours of the Columbia Basin Project, Grand Coulee Dam, Dry Falls, and Lake Roosevelt are needed.

To meet these needs, an interdisciplinary study to identify the many scenic, historic, and unique areas, and to prepare a plan for their preservation is recommended. Also, a similar study is necessary to consolidate all recreation and scenic programs into a scenic parkway along the upper Columbia River.

Other Measures The high country in the Cascades has a fragile ecological balance and, while the apparent need is to increase the recreational capacity through a strong development program, care must be taken lest the resource itself be destroyed. A study is needed to find answers to the question of the proper level of human use in the high country, prior to initiation of development programs. Both winter and summer sport activities are involved. The study should be completed as early as possible to prevent any irreversible damage by the ever increasing number of recreationists.

The Pend Oreille River from Albeni Falls downstream to the Box Canyon Dam is filled with abandoned piling which obstructs the recreational use of the river and impairs the scenic values. However, some pilings that serve as nesting habitat for ospreys and geese should be preserved. Some other rivers in the area have similar situations and the removal of all piling not important to wildlife is recommended as soon it serves its purpose.

Additional elements of the plan contributing to the preservation and enhancement of the natural environment are discussed under water quality, fish and wildlife, and recreation.

Fish and Wildlife

The upper Columbia River area offers a great potential for development, utilization, and harvest of the renewable fish and wildlife resources. The framework plan contains measures to maintain or improve the existing fish and wildlife resource base and, insofar as possible, to meet the projected fishing and hunting user-day needs shown in table 41. Major elements for fish and wildlife are shown in table 42, Framework Plan Composition. These measures do not include mitigation measures necessary to offset conflicting land and water uses that would otherwise reduce fishing and hunting opportunities.

Fish The framework plan includes studies to consider preservation and protection of fisheries habitat on an estimated 3,000 miles of streams in the area, more than two-thirds of which are in Subregion 1. Streams having habitat worthy of consideration are listed in table 52.

Habitat improvement practices would be applied on about 2,300 miles of streams including such measures as stream channel preparation, spawning bed improvement, development of artificial spawning channels, rearing ponds, and nongame fish control. Habitat improvement practices would also cover 83,000 acres of lakes in the area. Habitat surveys included in the first time period include 4,400 miles of stream survey and 23,600 acres of lake survey. Adequate streamflows during the summer months, when water supplies are generally at a minimum, are vital for fish habitat protection and improvement.

Table 52 - Fish Habitat Considered for Preservation, Area A

Stream	Reach
Flathead Lake Tributaries	All tributaries except main Stem of Flathead River.
Flathead River	Middle, North, and South Forks.
Lake Pend Oreille Tributaries	All tributaries except Clark Fork.
Priest Lake Tributaries	All tributaries.
Coeur d'Alene Lake Tributaries	All tributaries except Coeur d'Alene River.
Methow River	Origin to Columbia River.
West Fork Methow River	Origin to Methow River.
Wenatchee River	Wenatchee Lake to town of Leavenworth.
Little Wenatchee River	Origin to Wenatchee Lake.
White River	Wilderness Area to Wenatchee Lake.
Yakima River	Origin to Columbia River.
Naches River	Origin to Yakima River.
American River	Origin to Naches River.
Bumping River	Origin to Naches River.
Tieton River	Origin to Naches River.
North Fork Tieton River	Origin to Naches River.
South Fork Tieton River	Origin to Naches River.
Teanaway River	Origin to Yakima River.
North Fork Teanaway River	Origin to Teanaway River.
Middle Fork Teanaway River	Origin to Teanaway River.
West Fork Teanaway River	Origin to Teanaway River.
Cle Elum River	Origin to Yakima River.
Columbia River 1/	Priest Rapids Dam to McNary Pool.

1/ A detailed interdisciplinary study is recommended to determine the best plan for use of this reach of the Columbia River.

The Fish and Game Department of the State of Idaho has made preliminary estimates of the minimum flows required for fish habitat in the Idaho part of the area. Establishment of realistic minimum flows is a prime requisite for water resource planning, and special studies required to develop minimum flows for the entire area are made a part of the framework plan and shown in "Nature and Extent of Further Study." These studies

should also develop means to satisfy or meet the minimum flows. In many cases, storage will be required to augment seasonal low flows.

In the upper Columbia River area, there is little opportunity for increasing the harvest of anadromous fish. Most of these stocks are presently being utilized to capacity. Steelhead migrating through mainstem reservoirs are largely unharvested. Resident trout angling in Subregions 2 and 3 is primarily dependent upon artificial propagation, and harvest is keyed directly to the number and size of fish stocked. There are opportunities to increase utilization of the resource by improved access. The program to improve lake and stream access includes acquisition of or easements to 2,400 miles of streambank and more than 400 lake access sites. Some of the lakes and streams are presently accessible but access areas need to be modified and enlarged to accommodate future needs. Warm water fish populations have a capacity for significant increased use. Additional access for resident trout angling would also benefit the warm water fishery where both groups are found. Future needs for warm water fish will be satisfied through year 2020, providing the present level of management continues.

Increased production in existing hatcheries can be accomplished through water reuse, controlled environment, improved feeds, disease abatement, and many other techniques. A total of 17 new or expanded hatcheries is necessary in the area to meet future needs. Existing ponds or small impoundments suitable for rearing anadromous fish need to be identified and reserved for this purpose. The framework plan includes an additional 500 acres of small impoundments for rearing purposes. In Subregion 2, possible areas for rearing salmon and steelhead smolts are: the lower Crab Creek area; Priest Rapids area; Quincy Game Range area; and areas along the Methow and Wenatchee River systems. Areas for rearing salmon and steelhead in Subregion 3 comprise an abandoned irrigation canal on the Yakima River near Richland; Richland and Barker ponds on the Yakima River at Richland; and Horseshoe pond on the Yakima River near Mabton.

Wildlife The framework plan provides for wildlife habitat improvement on an estimated 4.2 million acres between 1970 and 2020 (Subregion 1 - 375,000 acres; Subregion 2 - 2,419,000 acres; and Subregion 3 - 1,359,000 acres). Improvement practices include development of shallow impoundments, potholes, and guzzlers; seeding and planting of wildlife food crops; forage release and burning; establishment of permanent openings; key area fencing of more than 800 miles; and nesting facilities and marsh developments. Habitat improvement will be accomplished in

part by these specific wildlife practices and in part from multiple-use management practices that give priority consideration to wildlife habitat in critical winter range areas and important upland game and waterfowl areas. Measures to increase hunting will also include augmentation of bird supply by game farm rearing of some 322,000 game birds.

Land acquisition is planned either by fee purchase or easement rights to assure control of wildlife habitat on more than 1.1 million acres. These areas would be managed by fish and wildlife agencies specifically for protection and enhancement of wildlife resources. A number of the above habitat improvement practices will be effected on these lands.

Approximately 21.7 million acres have significant wildlife resources but their use and harvest are limited by inadequate public access. To meet increased hunter demands and make full use of these resources, additional access must be provided. Many of these areas are in private ownership. Specific acreages for access corridors have not been developed. These and other wildlife habitat preservation, enhancement, and harvest requirements will be better identified following development of big game range analysis on some 2.6 million acres, upland game habitat surveys on 7.5 million acres, and nearly 200 habitat management plans, all scheduled in the 1970 to 1980 time period.

Land and Water Requirements Table 53 shows some of the significant water and land projections associated with fish and wildlife plan elements.

Table 53 - Planned Fish & Wildlife Land and Water Requirements, Area A

Item	Units	1970	1980	2000	2020
Fish hatchery water withdrawals	1,000 ac-ft	238	293	348	392
Water withdrawals for wildlife areas1/	1,000 ac-ft	29	61	82	91
Fish & wildlife water areas2/	1,000 ac	872	883	890	897
Wildlife land use3/	1,000 ac	38,767	38,442	38,170	37,889
Controlled wildlife land use4/	1,000 ac	616	1,164	1,386	1,760

1/ Includes water developments, and access primarily developed for waterfowl enhancement.

2/ Includes small critical fishing waters (less than 500 acres each) and high quality waterfowl habitat.

3/ Most land area is used in varying degrees by wildlife. Available lands will slowly be reduced by infringement of urban and industrial areas, development of special use areas, and increased reservoir water areas despite requirement for enhancement of wildlife resources and increasing hunting demand.

4/ Lands operated or owned and managed by fish and wildlife agencies specifically for wildlife control and enhancement.

Outdoor Recreation

The range of elevations, landscape patterns, and ecological systems of the upper Columbia River area offer a wide selection of recreation attractions that bring tourists from all parts of the country, primarily during the summer vacation season. However, winter sports and associated activities, such as wildlife photography and sightseeing, are gaining in popularity.

Total water-related recreation use is expected to increase from 15.9 million recreation days in 1970 to 81.3 million by 2020. The plan includes a system of wild, scenic, and recreation rivers; picnicking, swimming, boating, water skiing, sightseeing, hiking, and camping areas, including facility developments for the increase of 65.4 million recreation-day needs between 1970 and 2020. The increase in recreation will entail use of 274,200 acres of water surface areas by 2020 as compared to 67,300 acres in 1970, and require facility development on an additional 32,100 acres of land. Projected recreation day use and required land and water areas are given in table 42, Framework Plan Composition.

Additional camping and picnicking facilities are needed near all urban centers, and overnight camping facilities need expansion. Some of the important locations are: Flathead, Whitefish, Coeur d'Alene, Pend Oreille, and Chelan Lakes; Hungry Horse Reservoir; many of the smaller lakes near Spokane and other urban centers; along scenic streams and mountain areas including the Kootenai, Chelan, Wenatchee, and Yakima River drainages. Development sites (BOR Class I and II areas) are planned on an additional 32,100 acres, mostly adjacent to present high-use areas. About 10,800 acres would be in private development, 15,600 acres in state and local governmental lands, and 5,700 acres in Federal areas.

Considering present recreation use, potential use, and future recreation needs for land under the various levels of government or in private ownership, most areas have adjacent lands available. However, counties and municipalities must acquire an estimated 8,500 acres of urban land to meet the needs. There are probably other localized areas where land acquisition is necessary but which have not been identified in this broad study.

Boating activity is rapidly increasing from the 1970 level of 72,000 boats and the large amount of water surface available in the upper Columbia River area stimulates this type of recreation. Table 54 shows the estimated number of pleasure craft and the associated launching lanes and land required to accommodate the boats.

Table 54 - Planned Elements, Recreation Boating, Area A

Sub-region	Pleasure Craft 1970	Pleasure Craft 1970-2020	Pleasure Craft Total	Launching Lanes 1970	Launching Lanes 1970-2020	Launching Lanes Total	Land Requirements 1970	Land Requirements 1970-2020	Land Requirements Total
		(1,000)			(each)			(acres)	
1	39	127	166	225	648	873	480	1,490	1,970
2	17	45	62	120	312	432	250	720	970
3	16	40	56	114	279	393	239 1/	626	865 1/
Area A	72	212	284	459	1,239	1,698	969	2,836	3,805

1/ Estimated.
Source: Appendix XIII, Recreation.

The Upper Columbia River area has sufficient water area to meet the projected water surface needs. Distribution of demand will pose some problems near urban centers when use surpasses the capacity of this resource. This will result in more travel to realize the same recreation pleasures.

The large reservoirs on the Columbia could absorb much of the projected demand in the central part of the area and could become a major alternative to recreational developments elsewhere. Interdisciplinary studies are recommended to select the best plan for long-range public needs, recognizing the possible conflicts between power and navigational use, and the preservation and utilization of natural environmental values. These studies should establish the effect of various levels of peaking operations and develop an overall plan for future use of the river and its related lands, including the consolidation of all recreation and scenic activities into a parkway with associated facilities along the entire river.

Thousands of miles of free flowing streams are available in the upper Columbia area, and a study which could lead to preservation of many of these streams is a vital part of the framework plan. In addition to the streams already officially designated as wild, scenic, or recreation rivers, table 51, Potential Recreation Streams, lists those streams that should be studied for possible preservation as free flowing streams for recreation and other purposes.

Scenic easements, the construction of viewpoints, and the removal of unsightly structures, including billboards, along highways having outstanding views of streams and their backgrounds

of forests and mountains should be undertaken. The highways listed in Appendix XIV, Recreation, should be studied for designation and management as scenic roads.

Related Land Programs

The framework plan includes a wide range of watershed measures and practices designed to reduce erosion and sedimentation, conserve and improve water quality, and alleviate flood damage and wetness problems through a combination of management practices, land treatment, and structural measures. Many different practices are required on some of the same land, some being recurrent in each planning period, and a number of measures would serve both improved watershed needs and production of other management objectives.

Erosion and sediment control practices would be applied on an additional 2.9 million acres of rangeland, 1.9 million acres of forest land, and 1.7 million acres of cropland between 1970 and 2020. Rangeland practices include grass seeding to establish protective cover along with brush and weed control, contouring, and road stabilization. In forest areas, trees and grass would be reestablished on eroding or deteriorating lands with particular attention following timber harvest, and existing or abandoned forest roads or trails would be stabilized. Cropland practices include grade stabilization structures, diversions, ditch bank seeding, crop residue use, and shifts to pasture and hay use in areas of higher erosion potential. Accompanying these measures, more than 11,000 detention structures and small check dams would be constructed in cropland and rangeland areas.

Onfarm irrigation needs can be partially met through careful water management and increased efficiency of present irrigation systems. Some systems now individually operated could be combined for more efficiency. Irrigation system improvements include land leveling and shaping, ditch lining and pipelines to reduce transmission loss, with additional onfarm storage and control facilities. Along with major water storage facilities, an estimated 1,900 ponds and small reservoirs would be developed with capacity of some 189,000 acre-feet to serve increased irrigation needs, store water for stock, recreation, and wildlife use, and conserve early spring runoff. The largest number of these structures would be scattered in rangeland areas.

With other management practices on forest land, some 244,000 acres require special attention to improve water yield. This includes manipulation of forest cover on 153,000 acres, 1,500 miles of snow fencing, and waterspreading on 74,500 acres. Forest and range lands require continuing protection and management

practices to restore and maintain an effective vegetative cover for watershed objectives and for increased production. Grazing use of lands must continually be adjusted to the grazing capacity of the land. A substantial number of livestock and game water facilities would be developed for better livestock and wildlife control and distribution. Timber sale contracts would include provisions for proper watershed protection practices, and improved harvest operations to assure a minimum temporary damage to the watershed. Continued fire protection and suppression would be effected in forest areas and critical rangeland areas. Watershed planning and management is a vital element to be included in all future land and resource development, and additional soil surveys and watershed plans would accompany future development.

Tributary stream control measures and adjacent land protection practices would help attain watershed objectives in erosion and sediment control, flooding, and water conservation. About 4,700 miles of bank stabilization work is proposed between 1970 and 2020 (500 miles in cropland, 2,600 miles in forest areas, and 1,600 miles in rangeland) along streams and reservoirs, primarily in Subregion 2. Some 400 miles of dikes and levees would be provided in croplands, mostly in Subregion 1. Channel improvement is planned along some 9,200 miles of streams and rivers, with about 81 percent in forest areas. This includes a variety of practices such as removal of obstructions and debris, measures for reduction of pollution and improved water quality, and clearing the way for fish migrations.

These land treatment and management practices have been grouped into several major categories as listed in table 42, Framework Plan Composition. Frequently, cooperative effort by a group of land managers and owners is necessary to effectively install a combination of practices, land treatment measures, and water conservation and control structures necessary to meet the more intensive multiple-use requirements of lands and resources. Small watershed areas requiring such coordinated efforts are shown in table 42 as future studies. Evaluation studies are required to properly select the areas most favorable for development. A substantial amount of the watershed programs and land measures practices included in the plan would be accomplished in these areas.

Nature and Extent of Further Studies

Watershed Studies Studies are called for on 130 watersheds in the first time period and 110 more by 2000 to refine and check the inventory data, evaluate and select those most desirable, justified, and able to fulfill the requirements of the scheduled plan.

River Basin Studies In several basins in the upper Columbia River area, problems are complex and available data are not sufficient to select the best plan from an array of possible alternatives. Accordingly, interdisciplinary studies are recommended for the six subareas to further identify alternative methods, programs, projects, and uses of water and related land resources to consider multiple-purpose features of each project or program, to evaluate the impact of alternative land uses and projects on the environment, and to select proper alternatives and agencies to carry out the features of the resulting plan.

Studies relevant to future, more detailed planning which are now underway by State and Federal agencies in the upper Columbia River area are listed in table 55. These studies cover most of the river basins or subareas proposed for further studies. Although many have broad authority for planning water and related land resources, they have been generally confined to the area of interest of the agency concerned. Accordingly, the scope of these efforts should be expanded to make them fully interdisciplinary in nature, using the expertise of agencies in both Federal and State governments.

The following describes by basin or subarea the major problems or conflicts requiring resolution and the present coverage of major ongoing studies.

The Flathead River Subarea, Montana The Flathead River Basin has environmental values, the retention of which is a major consideration. Also, there are large potentials for irrigation, power, and flood control. Additional studies are required to evolve a plan which retains the high environmental values of the basin and still provides an acceptable level of development for power, irrigation, flood control, water quality control, and industrial uses.

The Corps of Engineers is studying the Clark Fork and Flathead River Basins to determine if any modifications to existing projects or additions thereto are advisable. This study is currently scheduled for completion in fiscal year 1976. The Soil Conservation Service and Forest Service are studying the Flathead-Whitefish Lake area and the Calispell-Trimble watershed in the lower Pend Oreille area. The Geological Survey is conducting surface and ground-water studies in the Flathead and upper Clark Fork Basins.

The Bureau of Reclamation is making a multiple-purpose study of the Stillwater Division of the Flathead River Project and the report is currently scheduled for completion in FY 1973.

Table 55 - Studies Underway, Area A

Study	Purpose	Agency	Completion
St. Joe River	Flood Plain Information	CE	1972
St. Joe River	Wild River	FS	1973
Priest River	Wild River	FS	1974
Moyie River	Wild River	FS	1974
Coeur d'Alene Reservation	Soil & Range Inventory	BIA	1973
Rathdrum Prairie	Recharge	GS	1971
Whitefish Lake	Multiple-Purpose	SCS-FS	1971
Clark Fork-Flathead River	Multiple-Purpose	CE	1973
Flathead River	Wild River	FS	1973
Clark Fork-Flathead River	Water Resource Studies	GS	1973
Lower Flathead Basin	Hydrologic Study	GS	1974
Flathead River-Stillwater Div.	Multiple-Purpose	BR	1973
Glacier National Park	Water Resource Inventory	GS	1977
Cottonwood Creek, Deerlodge	Flood Control	CE	1971
Kootenai River near Libby	Libby Reregulating Dam	CE	-
Blackfoot River Valley	Ground-water Studies	GS	1971
Spokane River Basin	Multiple-Purpose	CE	1974
Spokane River Basin	Multiple-Purpose	BR	1976
Bockemuchl Watershed	Multiple-Purpose	SCS	-
Mill Creek	Multiple-Purpose	SCS-FS	-
Little Pend Oreille	Multiple-Purpose	SCS-FS	-
Chewelah Creek	Multiple-Purpose	SCS-FS	-
Calispell-Trimbel	Multiple-Purpose	SCS-FS	-
Columbia River & Tributaries	Multiple-Purpose	CE	1977
Spokane River	Flood Plain Reg. Study	State of Wn.	1971
Crab Creek	Flood Plain Reg. Study	State of Wn.	1971
Little Spokane River	Flood Plain Reg. Study	State of Wn.	1971
Colville River	Flood Plain Reg. Study	State of Wn.	1971
Pend Oreille River	Flood Plain Reg. Study	State of Wn.	1971
Crab Creek Basin	Multiple-Purpose	CE	1974
Central Washington Area	Multiple-Purpose	BR	1976
Douglas Creek	Multiple-Purpose	SCS	-
Lower Moses Coulee	Multiple-Purpose	SCS	-
Goose Creek	Multiple-Purpose	SCS	-
Upper Coulee	Multiple-Purpose	SCS	-
Okanogan River Basin	Multiple-Purpose	CE	1977
Chief Joseph Project-Okanogan Unit	Multiple-Purpose	BR	1971
Chief Joseph Project-Oroville Tonasket Unit	Multiple-Purpose	BR	1973
Yakima Project-Ahtanum Unit	Multiple-Purpose	BR	-
Yakima River & Tributaries	Multiple-Purpose	CE	1976
Toppenish-Simcoe Project	Multiple-Purpose	BIA	-
Wapato-Satus Creek Project	Multiple-Purpose	BIA	-
Mabton Project	Multiple-Purpose	BIA	-
Klickitat Project	Multiple-Purpose	BIA	-
Cowiche Creek	Multiple-Purpose	SCS-FS	-
Manastash-Taneum	Multiple-Purpose	SCS-FS	-
Wenas Creek	Multiple-Purpose	SCS-FS	-
Wilson Creek	Multiple-Purpose	SCS-FS	-
Naches River	Flood Plain Information	CE	-
Columbia Basin Project	East High & East Low Ext.	BR	1973
Yakima Indian Reservation	Water Resource Inventory	BIA-GS	1972
Columbia Basin Area	Ground-Water Studies	GS	Continuing
Mission Mtn. Primitive Area	Wilderness Classification	FS	1971
Alpine Lakes Area	Wilderness Classification	FS	1973 (Hearings)
Enchantment Area	Wilderness Classification	FS	1973 (Hearings)
Mt. Aix Area	Wilderness Classification	FS	-
Glacier National Park	Wilderness Classification	NPS	-
Idaho Batholith	Management Plan	FS	1976
Colville Indian Reservation	Water Resource Inventory	BIA-GS	1975
Dry Creek, Ephrata	Flood Control	CE	1922
Columbia River, McNary to Wenatchee	Navigation	CE	1975

The Forest Service is studying all three forks of the Flathead as potential additions to the wild and scenic rivers system.

Spokane River Subarea, Idaho and Washington The Spokane River Basin is faced with serious water supply and quality problems. Augmentations of streamflows are needed for water quality and for fishery, as well as for irrigation. Development of a comprehensive plan which would provide water in the Spokane-Coeur d'Alene Rivers acceptable for esthetics and fish and wildlife and provide water for irrigation and power is necessary. An alternative including upstream storage in Idaho should be examined to determine whether such storage can be developed in a manner compatible with environmental quality. A number of other alternatives are available.

The Corps of Engineers started a study of the Spokane River and its tributaries in fiscal year 1967 to determine if improvements for flood control, waste water management, and other purposes are advisable. The study is scheduled for completion in FY 1974. Also the Bureau of Reclamation is scheduled to begin a reconnaissance level study of the multiple-purpose water needs of the basin in 1974 with completion tentatively scheduled for 1977. The Soil Conservation Service has a Public Law 566 study underway of the Bockemuchl watershed.

The Main Stem of the Upper Columbia River Except for 57 miles of open river below Priest Rapids Dam, the Columbia River from the Canadian border to Wallula Lake, the reservoir behind McNary Dam is contained in a series of seven dams and reservoirs. As power generation shifts to a thermal base, the installation at some of these projects will be expanded and the system will operate more and more for peaking with resulting fluctuations in the open river stages. Alternatives for use of the river range from no further development to full structural installation, including the extension of barge navigation to Wenatchee. Studies are required to select the best plan for long-range public needs, recognizing the possible conflicts between power and navigational use of the river and the preservation and utilization of natural environmental values. These studies should establish the effect of various levels of peaking operations and develop an overall plan for future use of the river and its related lands, including consolidation of all recreation and scenic activities into a parkway with associated facilities along the entire river.

The Corps of Engineers is making a full study of the Columbia River and tributaries pursuant to a resolution adopted July 1962 and should provide much of the needed information.

The study began in fiscal year 1969 and is tentatively scheduled to be completed in 1977.

Big Bend Subarea, Washington The Big Bend Subarea needs water for irrigation and for low flow augmentation for water quality, fish and wildlife, and esthetics. Control of high flows to avoid flood damages is also required. A combination of physical measures must be studied to develop a plan which insures compatibility between the water and related land functions.

The Corps of Engineers is studying the Crab Creek Basin for flood control and other water uses. The study is scheduled for completion in fiscal year 1974. The Bureau of Reclamation is making a reconnaissance study of the multiple-purpose water needs and uses for approximately 2.0 million acres in the central Washington portion of the subarea. The study began in FY 1972 and is scheduled for completion in FY 1976. Also, the Soil Conservation Service has the following watershed studies underway in this subarea: Douglas Creek, lower Moses Coulee, Goose Creek, and Upper Coulee.

Okanogan River Subarea, Washington The Okanogan River Subarea is short of water for irrigation and is in need of low flow augmentation for water quality control. Flood control is also needed. Alternatives range from upstream storage in Canada to modernizing and improving existing irrigation systems. An interdisciplinary study fully coordinated with an ongoing study in Canada is required to determine the best plan to control and augment water supplies for irrigation and to resolve water quality problems.

The Corps of Engineers began a study of the Okanogan Basin in FY 1971, in the interest of flood control and other water uses, which is scheduled for completion in FY 1977. The Bureau of Reclamation has multiple-purpose water use studies underway for the Oroville-Tonasket Unit Extension and the Okanogan Unit, both parts of the Chief Joseph Dam Project. These are scheduled for completion in FY 74 and FY 71, respectively. Also, that agency is scheduled to begin a reconnaissance study of the Okanogan River Basin in FY 74.

Water is available from the Columbia River and other sources to irrigate portions of the Colville Indian Reservation. Additional project type studies are required to develop the Indian lands.

Yakima River Subarea Present and future prosperity of the Yakima River Subarea is closely related to the quantity and quality of its water supply. Water quality is adversely affected by waste effluents and from agricultural return flows. The basin is also subject to recurring flood damages. Anadromous fish production has declined primarily due to low river flows, poor fish passage facilities, and overfishing. The Yakima Indian Reservation needs additional irrigation water. Studies are required to determine the best means of providing adequate water for irrigation and improving the quality of the river water. Alternatives include adjusting operations of existing reservoirs and interbasin water transfers. The rights of the Yakima Indian Reservation must be considered in any solution.

The Corps of Engineers initiated a study of the Yakima River for flood control and other purposes in FY 1972. The Bureau of Reclamation is completing a study of the enlargement of Bumping Lake. This proposed project is urgently needed to: augment streamflows for improvement of fishery resources; provide storage for improved flood control operations; and supply supplement water for irrigation. That agency is also completing a study of the multiple water uses for Ahtanum Creek. Other studies underway in the basin are the Cowiche Creek, Manastash-Taneum, Wenas Creek, and Wilson Creek watersheds by the Soil Conservation Service and Forest Service and the Toppenish-Simcoe, Wapato-Satus Creek, Mabton, and Klickitat Projects which would serve lands of the Yakima Indian Reservation.

Special Studies Table 56 lists special studies recommended for the area.

Table 56 - Special Studies, Area A

Type	Scope and Extent
Minimum Flow Requirements	Study of streams to establish minimum flows for esthetics, water quality, and fisheries. Include cross sections of streams where required.
Stream Preservation	Study of 2,170 miles on 33 streams to determine whether they should be included in a state or national system of recreation rivers. This includes 434 miles on four streams currently undergoing study.
Primitive Areas	Study approximately 550,000 acres of roadless areas for possible inclusion in Federal or State wilderness system.
Scenic, Historic, or Unique Areas	Identify scenic, historic, and unique areas, and develop plan for preservation and public use.
Habitat Improvement for Fish and Wildlife	Identify areas where habitat can be improved effectively and develop plan for improvement.
High Alpine Areas of Cascade Range	Determine level of human use commensurate with fragile ecological balance in high alpine areas of Cascade Range.
Upper Columbia River Shorelands	A detailed study of the effect of peaking operations and its effect on shoreland use and the development of a plan to guide future shoreland use, and the consolidation of all recreation and scenic activities into a recreation and scenic parkway.
Scenic Roads along Streams	A study of scenic roads along streams and development of scenic road plan with proposals for improving scenic opportunities.
Waste Water	Study of sewage drainage basins leading to preparation of water quality control and pollution abatement plans in conformance with established Federal-State guidelines.

Evaluations

General

The framework plan for the upper Columbia River area was formulated to satisfy functional needs that have been identified with full recognition given to preservation and enhancement of the natural environment. Through current surveys and followup detailed studies, impoundments, levee and channel improvements, irrigation facilities, and other structural elements would be located and designed to preserve as much as possible of the prime recreation, fish producing, wildlife, and esthetic areas. Key environmental areas would not only be preserved, but enhanced. Specific elements of the plan are briefly stated in the following:

(1) Preservation and enhancement of the environment would be assured by:

Establishing realistic minimum flows on all streams on the basis of future studies to improve esthetic values and fish and wildlife habitat and to aid in pollution control.

Waste treatment to remove 85 percent of organic wastes from municipal and industrial effluents by 1980 and 90 percent by 2000.

Study of 2,170 miles of 33 streams to determine whether they should be included in state or national system of recreation rivers.

Preservation and protection of fish habitat on 22 stream systems. The improvement of habitat on 2,300 miles of streams and 83,000 acres of lakes. Augmentation of the supply of fish from 17 hatcheries and 500 acres of rearing ponds. Provide access to 2,300 miles of streams and 411 access sites to lakes.

Acquisition of wildlife habitat on 1.1 million acres and improvement on 4.2 million acres. Over 300,000 game birds would be produced annually on game farms and hunting access would be improved on 21.7 million acres.

Recreation development to provide for an increase of 7.7 million recreation days by 1980, 28.4 million days by 2000, and 65.4 million days by 2020. Facility development would be required

on 32,100 acres and 8,500 acres of land would be acquired for urban recreation.

Landscape management and control including removal of old piling from rivers.

Expansion of designated wilderness and primitive areas.

Studies to consolidate recreation and scenic programs into scenic parkway along upper Columbia River and to determine proper level of human use of the fragile ecology of the high Cascade Range.

(2) Food and fiber needs would be met by:

Eight million acre-feet of water, 7.5 million acre-feet from surface and 0.5 million acre-feet from ground water for supplemental water for 338,000 acres of presently irrigated lands and 2,077,000 acres of new irrigation.

Multiple-purpose storage in the amount of 2,240,000 acre-feet to augment flows for irrigation as well as providing flood control, recreation, and fisheries. The final location and scoping of storage is dependent on plans to be selected by detailed interdisciplinary studies.

(3) Commercial water transportation needs would be met by:

Extension of barge navigation by channel improvements and construction of three locks in existing dams after 1980 if found to be acceptable by interdisciplinary studies.

(4) Watershed management and treatment by:

Cooperative programs and practices would be accomplished on 240 watersheds; erosion and sediment control on 6.5 million acres; water conservation on 2.1 million acres; protection and management on 26 million acres; watershed improvement on 244,000 acres; drainage on 226,000 acres; bank stabilization on 4.7 thousand miles; 419 miles of dikes and levees; 9,200 miles of channel improvements; 11,270 erosion control structures; 1,907 small ponds and reservoirs.

(5) Electric Power would be provided by:

Sources located in the area and contributing to the region through installation of additional capacity of 8,500 MW at existing hydroelectric plants and 10,200 MW of thermal power by 2020, using evaporative cooling. Studies for pumped-storage and other generating means.

(6) Flood damage reduction would be provided by:

Flood plain management including flood plain zoning at 34 areas, flood information reports on 24 counties, and flood proofing at 15 locations; and 186 miles of levee and channel improvements. Although no single-purpose flood control storage was included, some flood control would be achieved through multiple-purpose storage. The only unmet need was flood control where residual damages on major streams of $5.7 million would remain at 2020.

(7) Municipal and industrial water would be supplied by:

Expansion of existing supplies which are generally considered adequate. About 672,000 acre-feet of water would be required to supply the 2020 needs.

(8) Further studies would be undertaken on:

Six river basins to select the best plan meeting public needs from an array of possible alternatives.

Nine special subjects requiring investigations to develop additional data.

In summary, the framework plan generally meets the projected needs except for flood damage reduction. All aspects require more detailed interdisciplinary studies to determine the best use for the area's water and land resources. However, the 57-mile reach of the Columbia River proposed for channel improvement in the interest of navigation is in conflict with a proposal to include this same reach in the national system of wild and scenic rivers and would be affected by future peaking operation of the river for power. Additional studies are especially required to resolve this particular problem which involves substantial economic and environmental considerations.

Water Resource Situation

Surface Water The total water supply is ample to meet both the projected consumptive and instream uses. However, because of seasonal differences in precipitation, streamflow, and needs, storage is required to provide flows for both types of use.

Between 1970 and 2020, the increase in surface withdrawals will be 7.856 million acre-feet and depletions will increase 4.410 million acre-feet. An additional 565,000 acre-feet are planned for diversion from Lake Roosevelt into Subregion 6 in the 2000 to 2020 period to meet irrigation needs. Table 57 shows a breakdown of these figures by time and use.

The mean annual streamflow of the upper Columbia River area, under 1970 levels of development, is approximately 115.8 million acre-feet which includes 69.4 million acre-feet of inflow from Canada. Under the projected 2020 conditions, the area streamflow would be reduced to slightly less than 112 million acre-feet. The largest depletion, about one-half, will be in Subregion 2, followed by Subregions 1 and 3 respectively. The most significant reduction is in Subregion 3, where the projected depletion of surface water is about 10 percent of the total average annual streamflow. Depletions in each of the other two subregions amount to about 3 percent. As shown in table 57, irrigation needs comprise about 95 percent of the total withdrawals and 96 percent of the depletions.

The two primary instream uses of water in the upper Columbia River area are fish and hydroelectric power. Other important uses are water-contact forms of recreation, waterfowl, pleasure boating, and intermittent commercial navigation on some lakes and reservoirs. A potential exists for substantial commercial shallow-draft navigation in the main stem Columbia River up to Wenatchee.

This portion of the region has some of the largest storage reservoirs and powerplants in the entire system. The major powerplants have a total installed capacity of about 9 million KW and several million under construction, mainly by addition to existing plants.

Ground Water The areawide ground-water supply is adequate to meet all projected needs and the estimated annual recharge is more than adequate to maintain the supply, although local shortages occur and more may develop. The estimated annual recharge is 27 million acre-feet and the estimated annual ground-water withdrawal in 2020 is only 2,044,000 acre-feet.

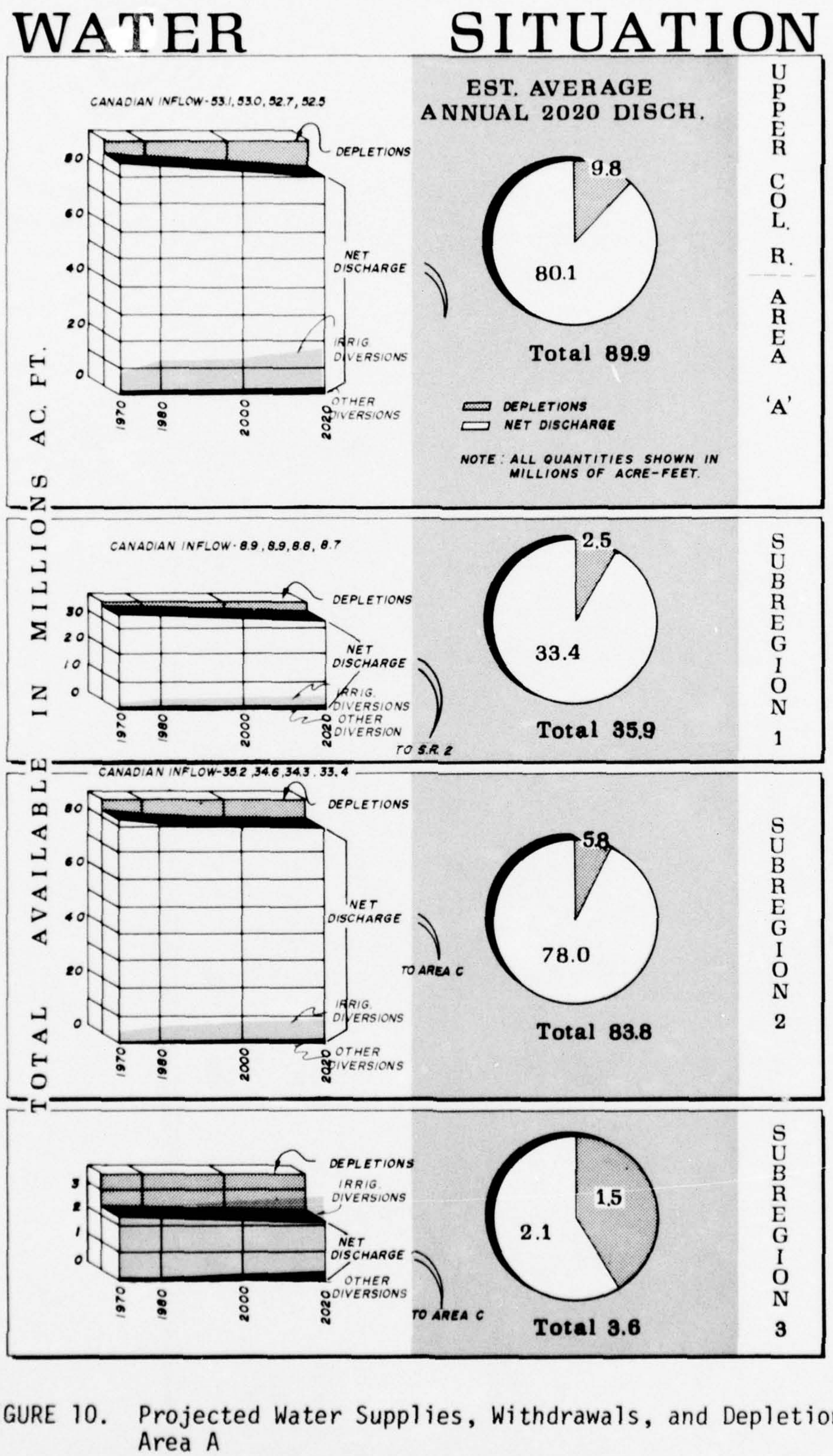


FIGURE 10. Projected Water Supplies, Withdrawals, and Depletions, Area A

Table 57 - Summary of Water Withdrawals and Depletions, Area A

Use	Ground				Surface				Total			
	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020
						(1,000 ac-ft)						
						Withdrawals						
Municipal	180	225	332	468	53	67	99	143	233	292	431	611
Industrial	195	239	296	362	69	87	113	143	264	326	409	505
Rural-Domestic	69	80	99	122	0	0	0	0	69	80	99	122
Irrigation	627	785	927	1,085	7,576	11,020	12,386	15,662 1/	8,203	11,805	13,313	16,747 1/
Thermal Power	0	0	0	0	800	23	78	195	800	23	78	195
Fish & Wildlife	2	6	7	7	265	348	423	476	267	354	430	483
Other	-	-	-	-	-	-	-	-	-	-	-	-
Total	1,073	1,335	1,661	2,044	8,763	11,545	13,099	16,619	9,836	12,880	14,760	18,663
						Depletions						
Municipal	35	46	66	93	11	13	20	28	46	59	86	121
Industrial	39	47	59	72	14	18	23	28	53	65	82	100
Rural-Domestic	14	16	19	24	0	0	0	0	14	16	19	24
Irrigation	349	439	513	614	4,498	6,158	6,549	8,635 1/	4,847	6,597	7,062	9,249 1/
Thermal Power	0	0	0	0	-	23	78	195	-	23	78	195
Fish & Wildlife	2	3	3	5	36	56	71	83	38	59	74	88
Other	-	-	-	-	-	-	-	-	-	-	-	-
Total	439	551	660	808	4,559	6,268	6,741	8,969	4,998	6,819	7,401	9,777

1/ Includes transmittal of 565,000 acre-feet from Subregion 2 to Subregion 6.

The major ground-water recharge is in Subregion 1, 19 million acre-feet, followed by Subregions 2 and 3, with 6 and 2 million acre-feet respectively.

The upper Crab Creek Basin is one localized area that is already experiencing shortages. The water table is rapidly being lowered by wells developed for agricultural uses. On the other hand, many areas now being irrigated from surface supplies are experiencing rapid rises in the ground-water tables.

As in surface water, irrigation accounts for the greatest use. About 50 percent of the withdrawals and 75 percent of the depletions will result from projected irrigation use.

Land Resource Situation

There are more than adequate land resources to meet all projected needs and, with adequate planning, retention and enhancement of the area's natural environment can be accomplished. Table 58 shows the planned cover and land use by time and subregions.

The framework plan proposes establishment of zoning regulations for development on all flood plains with these regulations incorporated into an overall land use plan for each county and state.

Significant amounts of land are projected for irrigation development in all three subregions. Nearly all of the increases are expected to be accomplished by shifting from dryland to irrigated cropland. The small remainder will be some shift from forest and range to irrigated croplands. Much of the projected irrigable land in Subregion 1 is Class 3 and is located along narrow river valleys and on high benchlands in the areas of western Montana, northern Idaho, and Washington. Generally, the lands are scattered, in small tracts, and would require development by individuals rather than project-type facilities. In many of these areas the growing season is short and production will be mostly limited to forage-type crops.

Land use shifts other than agricultural total only a small part of the land area. However, with over 2 million acres projected for irrigation in central Washington, new towns would be formed and agricultural-based industry expanded. With the projected water and land transportation systems available in this area, the potential exists for other types of industrial expansion. This is expected to result in additional land areas being utilized for urban and industrial uses, but no estimates have been made of the extent of such land-use shift.

Recreation land use is projected to expand markedly, but the total land shift in comparison to the area total is small.

New wilderness areas and wild, recreation, and scenic rivers potentials are identified with studies proposed to select those most appropriate to satisfy the local and state needs as well as the national interest.

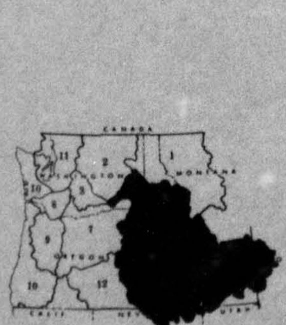
The upper Columbia River area contains significant big game, waterfowl, and upland bird habitat. The total natural habitat area is projected to decrease as a result of expanding cropland development, recreational expansion, and general development of roadways and towns. However, the big game animals and bird populations are expected to increase per unit of area due to more intensive management measures. In areas where big game winter habitat is becoming scarce or critical, the plan provides for curtailing competing land use.

It is essential that all resource uses for every parcel of land be considered in future planning and development. To insure that competing land resource uses are adequately provided for, a comprehensive land use plan should be developed by each state which establishes state goals and priorities.

Table 58 - Summary of Planned Cover and Land Use, Area A

	Planned Amount															
	Subregion 1				Subregion 2				Subregion 3				Area A Total			
Area Cover & Land Use	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020
								(1,000 acres)								
Rangeland	1,698	1,439	1,411	1,237	4,584	4,363	4,360	4,300	1,535	1,486	1,462	1,428	7,817	7,288	7,233	6,965
Forest Land	18,242	18,118	17,974	17,784	5,652	5,624	5,653	5,674	1,509	1,500	1,490	1,468	25,403	25,242	25,117	24,926
Commercial	(15,759)	(15,635)	(15,491)	(15,301)	(4,547)	(4,518)	(4,548)	(4,569)	(1,273)	(1,265)	(1,254)	(1,232)	(21,579)	(21,418)	(21,293)	(21,102)
Noncommercial	(2,483)	(2,483)	(2,483)	(2,483)	(1,105)	(1,106)	(1,105)	(1,105)	(236)	(235)	(236)	(236)	(3,824)	(3,824)	(3,824)	(3,824)
Cropland	1,552	1,737	1,739	1,930	3,309	3,451	3,345	3,300	686	724	736	768	5,547	5,912	5,820	5,998
Irrigated	(465)	(833)	(925)	(1,280)	(707)	(1,242)	(1,448)	(1,866)	(490)	(536)	(552)	(590)	(1,662)	(2,611)	(2,925)	(3,736)
Nonirrigated	(1,087)	(904)	(814)	(650)	(2,602)	(2,209)	(1,897)	(1,434)	(196)	(188)	(184)	(178)	(3,885)	(3,301)	(2,895)	(2,262)
Other Land	1,327	1,414	1,530	1,644	536	570	616	662	121	135	153	173	1,984	2,119	2,299	2,479
Urban & Industrial	(212)	(225)	(245)	(272)	(108)	(114)	(122)	(131)	(52)	(57)	(65)	(73)	(372)	(396)	(432)	(476)
Remainder	(1,115)	(1,189)	(1,285)	(1,372)	(428)	(456)	(494)	(531)	(69)	(78)	(88)	(100)	(1,612)	(1,723)	(1,867)	(2,003)
Total Land Area	22,819	22,708	22,654	22,595	14,081	14,008	13,974	13,936	3,851	3,845	3,841	3,837	40,751	40,561	40,469	40,368
Water Surfaces 1/	452	563	617	676	288	361	395	433	29	35	39	43	769	959	1,051	1,152
Total Area	23,271	23,271	23,271	23,271	14,369	14,369	14,369	14,369	3,880	3,880	3,880	3,880	41,520	41,520	41,520	41,520
Ancillary Land Uses																
Fish & Wildlife	21,492	21,294	21,124	20,951	13,545	13,438	13,358	13,274	3,730	3,710	3,688	3,664	38,767	38,442	38,170	37,889
Water Related Recreation																
Facility Development	4	7	10	20	2	4	7	12	3	5	6	9	9	16	23	41
Total Irrigated Area	530	860	950	1,320	804	1,280	1,490	1,920	509	550	570	610	1,843	2,690	3,010	3,850

1/ Includes only large water bodies over 40 acres and streams over one-eighth mile in width. Smaller water areas are included in "other land" category.



AREA B

AREA B
SNAKE RIVER, SUBREGIONS 4, 5, and 6

Extending over portions of six states, the Snake River Area includes nearly 40 percent of the region but has only 13 percent of its people. It is of special significance to Idaho as it contains nearly 90 percent of the State and about 80 percent of its people.

Description

The Snake River Area, which consists of the entire Snake River drainage, extends over nearly 108,000 square miles of the southeastern part of the region in the States of Idaho, Nevada, Oregon, Utah, Washington, and Wyoming. The area is shown by subregions on figure 11.

From its origin in Yellowstone Park, the Snake River traverses the area in a great arc for a thousand miles before entering the Columbia River in southeastern Washington. Enroute, it is joined by numerous tributaries, the principal ones being the Henrys Fork, Owyhee, Boise, Payette, Weiser, Salmon, Grand Ronde, and Clearwater Rivers.

The extreme variations in elevation and topography of the area, combined with its great east-west length, produce a considerable range in climatic conditions. Average annual temperatures range from 40°F. to 50°F., but extremes of -63°F. and 118°F. have been recorded. Annual precipitation varies from 6 to 15 inches in the more arid parts to more than 70 inches in the mountains.

About half the area is rangeland, the bulk of which extends in a belt from Wyoming through southern Idaho and into eastern Oregon in Subregions 4 and 5. Forested mountains of mostly pine and fir occupy about a third of the area, of which over half are in Subregion 6. The bulk of the cropland is in Subregions 4 and 6. Dry cropland is largely devoted to hay and grain; irrigated land produces forage, grain, sugar beets, potatoes, vegetables, and fruits. Large numbers of beef cattle are raised throughout the area. The high elevation and consequent short growing season of a significant part of the cropland, while not allowing the type of cropping found in some other areas, nevertheless permits a prosperous agriculture. With controlled moisture through irrigation, most of the cropland is extremely productive of short-season crops for which the area is famous.

About 738,800 people lived in the area in 1970. The larger towns include Idaho Falls, Pocatello, Twin Falls, Boise, Nampa, Lewiston, Moscow, and Caldwell in Idaho; Baker, Ontario, and LaGrande in Oregon; Clarkston and Pullman in Washington.

The economy of the area is based to a major extent on irrigated agriculture and the related food-processing industry. Recreation, forestry and associated lumber, paper and pulp manufacturing are also important.

Transcontinental railroads and highways traverse the Snake River Valley above Hells Canyon. State and county roads provide access to all portions of the area except in the more rugged mountains. Several of the larger towns are served by commercial airlines and commercial navigation is available in the lower Snake River up to Lewiston.

Major water resource development is centered around hydroelectric power generation and irrigation. The area has about 3,370 megawatts of generating capacity, either installed or under construction. Irrigation is being provided to some 4.2 million acres, resulting in a net depletion to the water supply of about 8.4 million acre-feet.

The area is of national significance with respect to its unique recreation resources. Among the most outstanding of these are Yellowstone and Grand Teton National Parks, Craters of the Moon National Monument, Sun Valley, Jackson Hole, and Hells Canyon. In addition, over 2 million acres are included in the Eagle Cap and Selway-Bitterroot Wildernesses and in the Sawtooth, Idaho, and Salmon River Breaks Primitive Areas. Also, portions of four rivers, the Selway, Middle Fork Clearwater, Lochsa, and Middle Fork Salmon, are included in the national system of wild and scenic ivers. The main stem of the Bruneau River and the Salmon River from the town of North Fork to its confluence with the Snake River have been designated for study as potential additions to the system.

Although the Snake River Area has vast land resources and a reasonably abundant supply of water, the current and projected needs are also large. In some areas, conflicts already exist among several uses, especially recreation, fish, wildlife, and water quality on the one hand, and power development, irrigation, and flood control on the other.

An important need in the area is for protection and improvement of the land base through intensive land measures and improved multiple-use programs. Major problems needing attention include drainage, erosion and sedimentation, overgrazing, water management, logging and mining practices, and flooding.

Only a relatively small portion of the total drainage area is susceptible to flooding; however, those flood-prone areas are usually well developed and considerable damages can occur. Generally, these areas lie in narrow strips along the streams and include rich farmland, towns, and urban developments. Floods seldom cause loss of life but often result in extensive damage to lands, crops, buildings, highways, railroads, and irrigation facilities.

Snake River water quality is generally good, but problems do occur from time to time in some areas. Some stream segments are subjected to significant sediment and mineral loads. Bacterial concentrations are above recommended recreational limits near a number of population areas, and dissolved oxygen deficiencies have occurred intermittently at a number of points. Milner and American Falls Reservoirs and the lower Portneuf River have consistently demonstrated some undesirable water quality conditions at least part of the year. In addition, the Boise and Owyhee Rivers contribute significant waste loads to the Snake River.

Significant hydroelectric potentials occur in the area, particularly in the Lower Snake Subregion. However, conflict over development versus nondevelopment of the Snake River between Hells Canyon Dam and the mouth of the Salmon River, the desire to maintain the natural reproduction capability of the Salmon River's anadromous fish resource, and the wild river study of the Salmon River, make the development of a major part of this potential questionable. Although the regional power analysis made for the framework study indicates no need for thermal generation facilities in this area, geothermal development is being considered in the Raft River drainage.

Coupled with the Middle and Lower Snake River power development controversy are demands by recreational boaters from Lewiston for increased minimum flows below Hells Canyon Dam. Other recreation objectives involve setting aside suitable areas for wilderness, free flowing rivers for recreation and stream fisheries, and stabilizing the level of Jackson Lake. The area has potentials that can satisfy future recreational needs, given the proper detailed planning.

Fishery problems are principally those associated with protecting the anadromous fishery and providing adequate stable flows of suitable quality to maintain a quality resident fishery. Other fishery needs include stream barrier passage, fisherman access to streams, additional hatcheries, and screens on diversion works. The lower Snake River and its tributaries provide important spawning areas for anadromous fish. A major problem here is that of nitrogen supersaturation in the water below the spillways of dams, particularly at Lower Monumental, Ice Harbor, Little Goose,

and Lower Granite Dams. When all the generators are installed at these dams and Dworshak Dam is completed, much of the problem will be eliminated, except in years of excess runoff.

Wildlife needs are largely associated with habitat, preservation and improvement, especially big game winter range and waterfowl nesting areas. Some additional lands are also needed for upland game and fur bearers.

Additional water supplies for both new and supplemental irrigation are needed, especially in the Upper and Middle Snake Subregions. Upstream from Thousand Springs the surface-water supplies are almost fully appropriated in dry years. Although a large ground-water supply exists, the relationship between ground and surface water and the characteristics of the Snake Plain Aquifer are only partially known. Supplemental water is needed for over 1 million acres of currently irrigated land, and an additional 2.2 million acres of new irrigation would require development to meet projected needs.

The projected resource needs for the Snake River Area are summarized in table 59. The needs, in terms of water and land, are shown wherever possible.

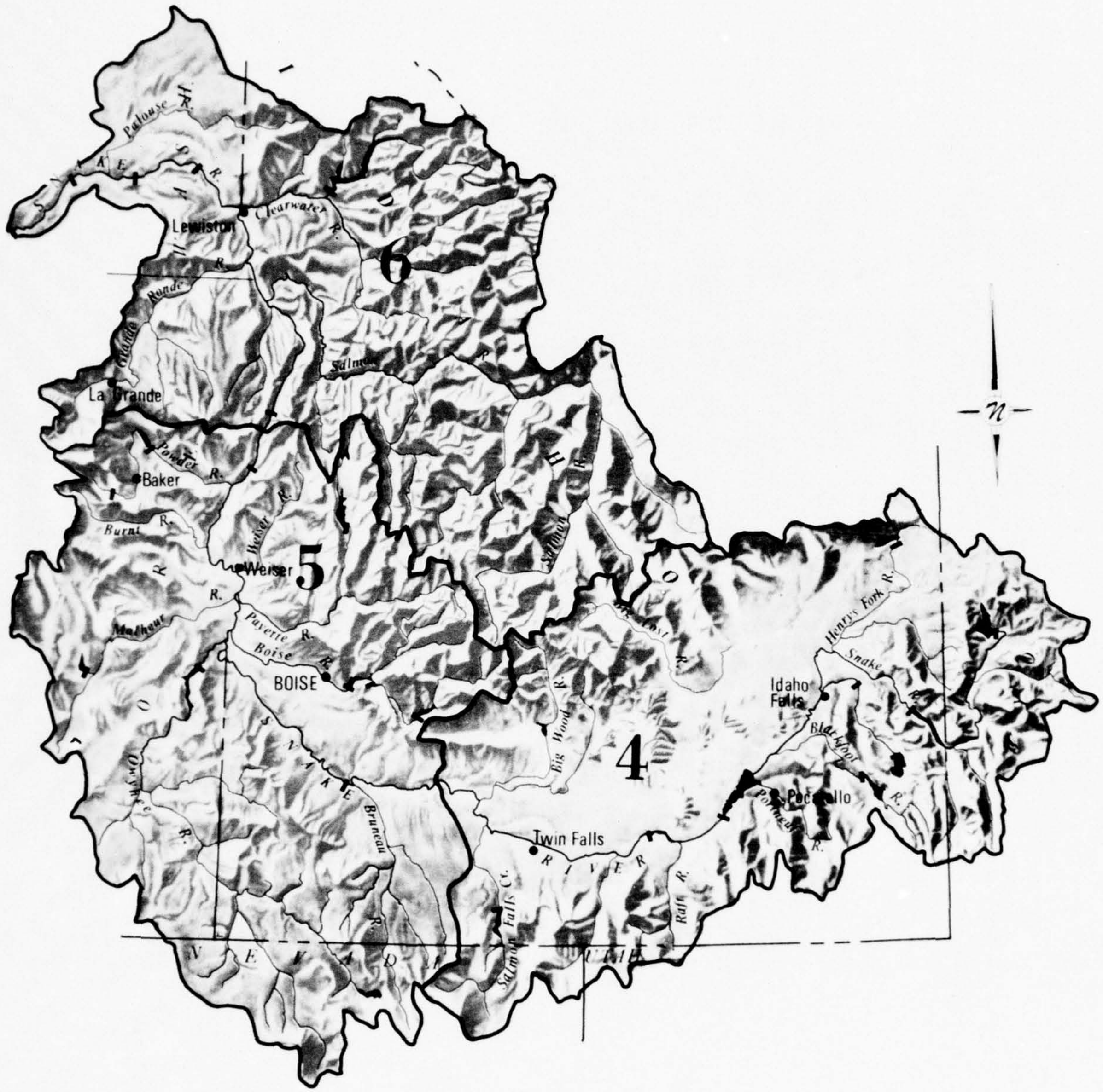


FIGURE 11. Plan Formulation Area B

Table 59 - Needs Summary, Area 8, Columbia-North Pacific Region

Purpose or Function	Units	Current (1970) Development	Projected Gross Needs 1980	Projected Gross Needs 2000	Projected Gross Needs 2020	Residual Needs 1980	Residual Needs 2000	Residual Needs 2020
Water Development and Control								
Electric Power								
Capacity (Peak)	mw			Only Projected on a Regional Basis				
Energy	mil kwh			" " " " " "				
Navigation								
Commerce	1,000 tons	470	1,800	3,600	6,700	1,330	3,130	6,230
Water Quality Control								
Raw Waste Production 1/	1,000 p.e.	5,481	7,586	11,411	15,377	2,105	5,930	9,896
Waste Removal 1/	1,000 p.e.	3,301	6,448	10,270	13,839	3,147	6,969	10,538
Municipal and Industrial Water								
Supply	mgd	386	494	712	969	108	326	583
Municipal	mgd	(134)	(173)	(265)	(374)	(39)	(131)	(240)
Industrial	mgd	(179)	(234)	(339)	(463)	(55)	(160)	(284)
Rural-domestic	mgd	(73)	(87)	(108)	(132)	(14)	(35)	(59)
Flood Damages								
Major Streams 2/	Ann. $1,000	2,762	-	-	-	3,914	6,063	9,894
Bank Erosion 2/	Ann. $1,000	2,650	-	-	-	2,796	3,006	3,410
Area Flooded 2/	1,000 ac	338	-	-	-	338	338	338
Irrigation								
Total Irrigated Area	1,000 ac	4,226	5,310	5,700	6,440	1,084	1,474	2,214
Water Short Area	1,000 ac	(1,030)	-	-	-	(1,030)	(1,030)	(1,030)
Water Supply	1,000 ac-ft	20,996	26,273	27,694	30,508	5,277	6,698	9,512
Water and Related Land Programs								
Fish and Wildlife								
Commercial Fishery 3/	1,000 lbs	-	-	-	-	-	-	-
Sport Fishing	1,000 days	2,177	3,084	4,089	5,328	907	1,912	3,151
Resident Species	1,000 days	(2,001)	(2,781)	(3,688)	(4,802)	(780)	(1,687)	(2,801)
Anadromous, Marine, Shell	1,000 days	(176)	(303)	(401)	(526)	(127)	(225)	(350)
Hunting	1,000 days	3,446	4,168	5,404	6,910	722	1,958	3,464
Water Related Recreation								
Development	1,000 rec days	13,900	22,100	42,700	78,400	8,200	28,800	64,500
Reg. Surface Water Use 4/	acres	35,000	46,300	86,500	158,200	11,300	51,500	123,200
Land Area (Rec. Facility Development)	acres	5,900	11,900	20,100	35,600	6,000	14,200	29,700
Pleasure Craft	no. (1,000)	30	39	72	133	9	42	103
Watershed Management								
Flood Damages--Minor Streams 2/	Ann. $1,000	12,336	-	-	-	16,184	19,605	23,294
Area Flooded 2/	1,000 ac	683	-	-	-	683	683	683
Erosion and Sediment Control	1,000 ac	7,733	12,264	18,467	24,558	4,431	10,734	16,825
Drainage	1,000 ac	162	285	397	536	123	235	374
Beach Erosion Control	miles	-	-	-	-	0	0	0
Bank Stabilization	miles	872	2,144	5,335	7,580	1,272	4,463	6,708
Levees and Floodwalls	miles	152	450	954	1,544	298	802	1,392
Channel Improvement	miles	1,410	3,359	6,691	9,639	1,949	5,281	8,229
Protection and Management 5/	1,000 ac	46,355	54,483	55,074	55,280	30,128	30,717	30,925
Water Conservation	1,000 ac	4,100	5,175	5,539	6,254	1,075	1,439	2,154
Water Yield Improvement	1,000 ac	0	39	90	146	39	90	146
Related Land Production								
Crop	1,000 tons	14,912	20,445	27,113	36,035	5,533	12,201	21,123
Irrigation	1,000 tons	(12,011)	(17,334)	(23,473)	(31,333)	(5,323)	(11,462)	(19,322)
Dryland	1,000 tons	(2,901)	(3,111)	(3,640)	(4,702)	(210)	(739)	(1,801)
Forest Wood Fiber	mil cu ft	343	383	454	504	40	111	161
Range Grazing Capacity	1,000 aum	4,116	4,774	5,697	6,261	658	1,581	2,145

1/ Includes municipal, industrial, and recreation use.
2/ 1970 needs over 1970 level of flood prevention.
3/ Not estimated, comm. fishery is negligible.
4/ Needs are a function of recreation day requirements.
5/ Includes recurrent programs that will require acceleration with implementation of a plan. Residual needs cannot be determined by subtracting current development from gross needs as many of these practices are applied annually on the same areas.

Formulation of Area Plans and Programs

In the Snake River Area there are numerous alternatives for meeting projected water and related land needs; but, in several instances, the satisfaction of some requirements would conflict with other uses and objectives. Major alternatives considered, the plan or program evolved, and the reasons for its selection are summarized by basins or subareas. In some places, additional studies beyond the framework level are necessary before a plan can be selected.

Water resource planning in this area must consider all rights to the use of water, including those established by treaties with the Nez Perce and the Shoshone-Bannock Indian Tribes, and by the executive order establishing the Duck Valley Reserve.

The Idaho Water Resource Board requested that the following statement be included: "A comprehensive plan has not evolved for the State of Idaho. The Idaho Water Resource Board, representing the State of Idaho in water resources planning functions, determined that a full comprehensive water resources plan for the State should not be fixed at this time. Many ongoing studies, such as joint State Wild River Studies, USDA Type 4 Study, and the Western United States Reconnaissance Study, will provide additional information on resource use. Therefore, Idaho has elected to delay formulation of a plan. However, alternatives have been identified and, where possible, studies have been outlined that would resolve conflicts and/or assist in the selection of a plan between competing uses." The use of the word "planned" in this document does not imply that a fixed plan has been developed.

Because of the position of the Idaho Water Resource Board it has been necessary to describe the framework plan developed for the Nevada, Oregon, Utah, Washington, and Wyoming portions of the Snake River Area separately from the "alternatives," "programs," or "considerations" developed for Idaho. However, the identification of needs, consideration of alternatives, and selection of means to satisfy needs employed in the framework planning for Idaho were the same as for the rest of the region. Only the terminology used to describe the results of this work is different.

Because of the scarcity of water and competition for its use, any discussion of plans, objectives, and alternatives for this area must be closely related to the management of flows in the Snake River. It provides the major source of surface water and is, therefore, the key to resolving conflicts and assuring the best use of available resources to meet needs. For this

reason, a discussion of the main stem of the Snake River is necessary before considering the various subareas through which it flows.

Main Stem Snake River

The Snake River originates in high, mountainous terrain in western Wyoming. Early developers, recognizing the need for regulation for irrigation, added 847,000 acre-feet of active storage space to the natural storage of Jackson Lake. Later, new storage was constructed at American Falls and Palisades, providing major regulation in the upper basin and furnishing irrigation storage for thousands of acres of land in Idaho. The combined storage of these three reservoirs is nearly 4 million acre-feet. Nevertheless, average or above runoff, which occurs in about two-thirds of the years, cannot be fully controlled; in the remaining years, the existing storage is more than ample.

Average annual flow of Snake River at the Idaho-Wyoming State line is 4.1 million acre-feet. Most of this water is committed for use downstream, but 4 percent has been reserved through the Snake River Compact of 1949 for diversion in Wyoming to satisfy needs in that State.

Although originally constructed primarily for irrigation use, the storage in Jackson Lake, Palisades, and American Falls is also managed to provide major benefits to recreation, flood control, and hydroelectric power generation. In dry years, recreation and environmental purposes suffer because of the prior rights of irrigators. This is particularly critical at Jackson Lake, which is located in Grand Teton National Park. It is imperative that studies of alternatives to stabilize water levels at Jackson Lake during the recreation season be undertaken. Some expansion of irrigation diversions in southern Idaho, which seems likely, will increase the dependency on existing storage and the related problem of drawdown at Jackson Lake. Stabilizing the lake would require replacement of 640,000 acre-feet of the active capacity elsewhere. Possible solutions to this problem may involve increased use of ground water, new surface storage, or some combination of the two.

Many surface storage sites have been considered in Wyoming and Idaho, both on the Snake River and on tributaries, to furnish replacement space for Jackson Lake. However, the more desirable sites are located in prime wildlife habitat areas or have other potential uses that must be carefully considered. Also, Wyoming interests prefer to have the replacement storage located in Idaho, as Jackson Lake space is owned and controlled by Idaho water users; Idaho interests prefer that the few remaining storage opportunities

in Idaho be reserved for additional development downstream and not to replace existing storage in Wyoming.

Major ground-water development of the Snake Plain Aquifer, operated in conjunction with existing surface storage, is one possible means for meeting demands. It may also be possible to pump ground water for irrigation during the summer and recharge the aquifer from Jackson Lake after the tourist season. These alternatives must be studied further before a decision can be made regarding new surface storage.

To reduce the possibility of ground-water drawdown, which might interfere with pumping levels or spring flows, about 1.5 million acre-feet of storage could be constructed in the Upper Snake Subregion for use in conjunction with recharge and development of the Snake Plain Aquifer. Potential main stem storage includes the Alpine site in Wyoming just above Palisades Reservoir; the Lynn Crandall site in Idaho just below Paisades Reservoir; or enlargement of American Falls Reservoir. Combinations of two or more sites on tributaries in Wyoming, such as the Blackrock site on the Buffalo Fork River, Cottonwood site on the Gros Ventre River, Granite Creek site on the Hoback River, and Elbow site on the Grays River rather than main stem storage, could also serve the same purposes. The storage would provide replacement space for Jackson Lake, at-site recreation, a resident fishery, flows for stream fishery and water quality enhancement, and storage for flood control, hydroelectric power generation, and irrigation. However, all of the more desirable reservoir sites are located in prime fish and wildlife habitat areas or have other potential uses that must be carefully considered. Moreover, the esthetic impact of reservoir drawdown at these replacement sites must be considered. Further study is needed to select the most appropriate site or sites and determine the ground-surface water relationship.

Water quality problems are relatively minor in the upper part of the basin; however, major population centers and industries at Idaho Falls, Blackfoot, and Pocatello discharge heavy loads of organic and other nutrient wastes into the river. Most of these are now taking steps to provide secondary treatment of all wastes. Return flows and runoff from adjacent lands also add pollutants. Water quality problems are frequently aggravated by a combination of heavy waste loads and greatly diminished flows, particularly below Blackfoot. Heavy algal growth in American Falls Reservoir has resulted in wide diurnal fluctuations in the dissolved oxygen concentration, which caused a fish kill in 1967. This condition is further aggravated by municipal and industrial waste loads in the Portneuf River which empties into the head of the reservoir. The major waste load in the Portneuf River, which comes from phosphate processing plants near Pocatello, has now been partially eliminated.

Milner Dam is the last point on the Snake River from which major gravity diversions can be made. Just downstream, the Snake River drops into a deep canyon and most of the irrigable land is on the higher adjacent plateaus. Major diversions at Milner essentially deplete all flows immediately below the dam in summer months of dry years, severely affecting instream needs. Good water quality in Milner Pool and upstream is generally maintained in summer months of most years by large flows carried in the river and diverted at Milner. After the irrigation season, however, when flows are reduced to fill upstream storage, the heavy waste loadings cause a critical water quality problem in Milner Reservoir. Flow augmentation and rigid controls on waste loadings are needed from Heise to Milner Dam. Flow augmentation could be supplied from storage, ground-water pumping, improved water management, or a combination of these. Minimum flows for water quality could be maintained with natural flow in the critical fall and winter months in preference to storage. When forecasts of runoff indicated a shortage of surface water, ground water could be pumped to make up the deficit. In most years, the deficit would be small and the costs reasonable. The ability to use either storage or ground water would help keep costs to a minimum.

Minimum flow requirements for fish and water quality have not been identified and are not now maintained in dry years immediately below Milner Dam because of prior water rights. The canyon is relatively inaccessible downstream and does not provide a good stream fishery, even in good water years, so recreation uses are not affected significantly. Measures to augment water quality flows upstream would also benefit fish in the nonirrigation season as the flows would be passed over the dam. During the irrigation season, however, diversions at Milner are large, and in dry years only minimal amounts pass over the dam. Alternative measures that would provide minimum summer flows for fish are upstream storage, ground-water pumping, more efficient upstream water use, or a combination of these.

About 50 miles downstream from Milner Dam, a new flow is established from the Snake Plain Aquifer at Thousand Springs. This water has excellent quality and a relatively stable flow. Irrigation diversions at this point would require pumplifts exceeding 500 feet to reach lands adjacent to the river, and even greater lifts to reach the vast acreages farther back. Large capacity multipurpose storage at either the Thousand Springs or Clear Lake site would be very useful to reduce pumplifts and provide water for several hundred thousand acres of high quality land, primarily on the Bruneau Plateau, and to serve other functions. However, the storage would inundate very attractive scenic areas, large fish hatcheries, powerplants, river pumps, and other developments. Therefore, major storage is not considered

feasible in this reach. Other alternatives are: pumping floodflows and surplus streamflows into offstream storage; limited expansion of direct river pumping to adjacent lands, primarily on the Bruneau Plateau; local ground-water pumping as the aquifer is recharged with surface supplies; transbasin diversions and exchanges with the Boise and Payette Rivers; an extensive canal system from Milner Dam to the Bruneau lands in connection with exchange ground-water pumping; water savings upstream; or meeting food and fiber needs elsewhere. Selection of the best alternative will require intensive analysis beyond the scope of this study.

Part of the alternative for effecting the Snake River-Boise River water exchange includes a dam in the Swan Falls area. This dam would impound water to facilitate delivery of Snake River flows to the lower Boise Valley in exchange for Boise River water to be used upstream in the vicinity of Mountain Home. The impoundment would replace the existing Swan Falls Dam and powerplant, provide increased hydroelectric power generation in that reach, and also serve growing recreational demands of the populated areas nearby. Minimum flows for fish and water quality could also be maintained in the Boise River by pumping from the Snake River.

The Boise, Payette, Owyhee, Malheur, and Weiser Rivers join the Snake River in Subregion 5 within the space of a relatively few miles. These tributaries add greatly to the flow of Snake River but also add sediment and other water quality problems. These problems could be partially solved by measures in the individual streams. Brownlee Reservoir, located a short distance downstream, acts as a major settling basin.

Locations exist for pumping from the Snake River to large acreages of potentially irrigable land in Idaho's Boise and Bruneau Basins and to Oregon's Owyhee, Malheur, Powder, and Burnt Basins. The reach just west of Weiser upstream to Nyssa is the primary one for pumping in Oregon due to the elevation and relatively stable pool behind Brownlee Dam.

Brownlee, Oxbow, and Hells Canyon Dams, which effectively harness the large flows and drop in elevation in about a 95-mile reach of the Snake River, have an installed hydroelectric power capacity of 942 megawatts and generate an average 615 megawatts of energy annually. Ultimate capability of these sites, assuming 2020 loads and resources, is 1,300 megawatts of installed capacity and 450 megawatts of energy These reservoirs also receive considerable recreation use.

The reach from Hells Canyon Dam to its confluence with the Grande Ronde River is a unique scenic area with great attraction for recreational pursuits. The 5,500-foot depth of the canyon

and fast-flowing water produce exciting adventure for boating, fishing, hunting, and camping in a wilderness setting. Minimum flows of 9,500 cubic feet per second, or the inflow to Brownlee Reservoir, whichever is less, have been suggested for the reach of the Snake River from Hells Canyon Dam to the Salmon River, as well as a reduction in water level fluctuations, to preserve and enhance recreational boating and other associated instream purposes. Considerable public interest has been expressed to retain this area as a scenic and wild river. Evaluation of these proposals must carefully consider their possible effects on upstream development.

If the proposed minimum flow of 9,500 cfs at Weiser is established without tying to the inflow to Brownlee Reservoir, this action would preclude nearly all future consumptive use development upstream and also reduce power production at the three existing hydroelectric plants below Weiser. Average annual flow of the Snake River at Weiser under 1970 conditions was 15,070 cfs. By 2020, projected irrigation and other upstream developments could reduce the average annual flow at Weiser to between 9,000 and 9,600 cfs. In addition, it is estimated that 903,000 acres of presently irrigated lands are water short. Based on average flows alone, serious conflicts arise between irrigation diversions and instream needs. When considering the limited upstream storage opportunities and flows during dry periods, the conflict is even more serious. An evaluation of the minimum flow proposals and the effects of such flows on upstream development is needed.

If the decision is made eventually to provide a minimum flow of 9,500 cfs or more, means will have to be identified to provide the necessary water. A recurrence of the 1928-32 dry period would inflict serious injury on most Snake River water users in Subregions 4 and 5 where there does not appear to be sufficient water to meet all of the projected needs. One alternative with several variations that would permit projected needs to be satisfied is to divert Salmon River water to southern Idaho. This could conflict with instream fishery needs of the Salmon River. Also, extensive ground-water pumping, improved water management, new surface storage, or some combination of these, could help augment streamflows.

The reach below Hells Canyon Dam also has potential for major hydroelectric power development. Numerous plans have been developed involving one or more dams at various locations to maximize power production. Each plan attempted to minimize adverse effects on anadromous fish and other environmental issues. The controversy has now been dampened somewhat with a proposed moratorium which would prohibit any type of development until after 1980. The Federal Power Commission has under consideration

a recommendation to permit development at the end of a 5-year period. Also, the Secretaries of Agriculture and Interior have recommended a study of this reach for inclusion in the national wild and scenic river system. Accordingly, the State of Oregon intends to initiate activities to reevaluate that State's policy regarding development of this reach of the Snake River.

Below Lewiston, Idaho, the Snake River is highly developed, with a series of four dams regulating flows primarily for slack water commercial navigation and run-of-the river hydropower production. Lower Granite, the uppermost of these four dams, extends slack water a few miles above Lewiston. The initial installed nameplate capacity of the four sites is 1,485 megawatts; the ultimate capacity can be increased to 3,033 megawatts. With the larger capacity, the plants could be used more for peaking purposes. Asotin Dam, authorized for construction by the 1962 Flood Control Act, would be located at the head of Lower Granite pool. It would have an ultimate capacity of 540 megawatts; with the addition of a navigation lock, commercial navigation would be extended some 30 miles upstream from Lewiston.

There is considerable state and local opposition to constructing Asotin Dam because of its potential impact on the Snake and Salmon Rivers anadromous fish runs. The primary alternative to its construction is nondevelopment, extending the scenic and wild river status of the Hells Canyon reach downstream to Lewiston, Idaho. The framework plan does not contain any recommendations except for future studies to select the most optimum use of this reach. Asotin Dam and powerplant, which is in a deferred category, is not included in the plan.

The elevated pools created by the four dams on the lower Snake River will facilitate irrigation development on adjacent lands. It is assumed that by 1980 private ventures would develop some 65,000 acres near the river by pumping. Development of lands farther from the river will generally require Federal and federally assisted projects. By 2020, a total of 133,000 acres are projected for development by river pumping.

Opportunity exists for development to enhance water-oriented recreation on the reservoirs. With development of adjacent lands to furnish feed near large bodies of water, waterfowl hunting is expected to gain in importance, along with hunting of upland game and trapping of fur-bearing animals.

Erosion is a significant source of pollution for the lower Snake as the adjoining area has the highest sediment yield of any subbasin in the Pacific Northwest. The only apparent solution is careful land treatment and watershed protection.

The discussion will now focus on the various subareas through which the Snake River flows, beginning with the South Fork Subarea at the headwaters and continuing downstream to the mouth.

South Fork Subarea (Subregion 4)

The South Fork Subarea shown in figure 12 contains portions of Yellowstone and Teton National Parks and adjacent national forests. These are very spectacular and scenic areas of major importance for esthetic values and recreational pursuits. Most of these unique lands and streams have been identified in the framework plan as being particularly suited to meet a significant portion of the recreation, fish, and wildlife needs. Consequently, structural developments in these areas should be limited and, where included, should be designed to minimize environmental conflicts.

Average annual flow of the Snake River at Heise is about 4.7 million acre-feet and exceeds 3 million acre-feet even in the dryer years.

Water quality problems are relatively minor at the present time. However, increasing visitor use at Teton National Park and housing construction in Jackson Hole give cause for concern because of the possibility of contamination.

Most of the irrigation development is scattered along the mountain valleys and depends largely on unregulated runoff. More storage is needed if a late-season supply is to be made available to most of these lands.

Flooding of lowlands is a frequent problem along the Snake River at Jackson Hole and along the Salt River in Wyoming. Zoning and levees, in conjunction with existing Jackson Lake storage, could effectively reduce damages in Jackson Hole. Storage appears to be the only means of preventing significant flood damage in the Salt River Valley. However, there would be some environmental conflict.

Major problems associated with cropland are irrigation water shortages, drainage, and erosion. Forest land needs reforestation, timber stand improvement, and runoff control. Rangeland needs cover improvement and revegetation. In addition, special cooperative programs are required on several watersheds.

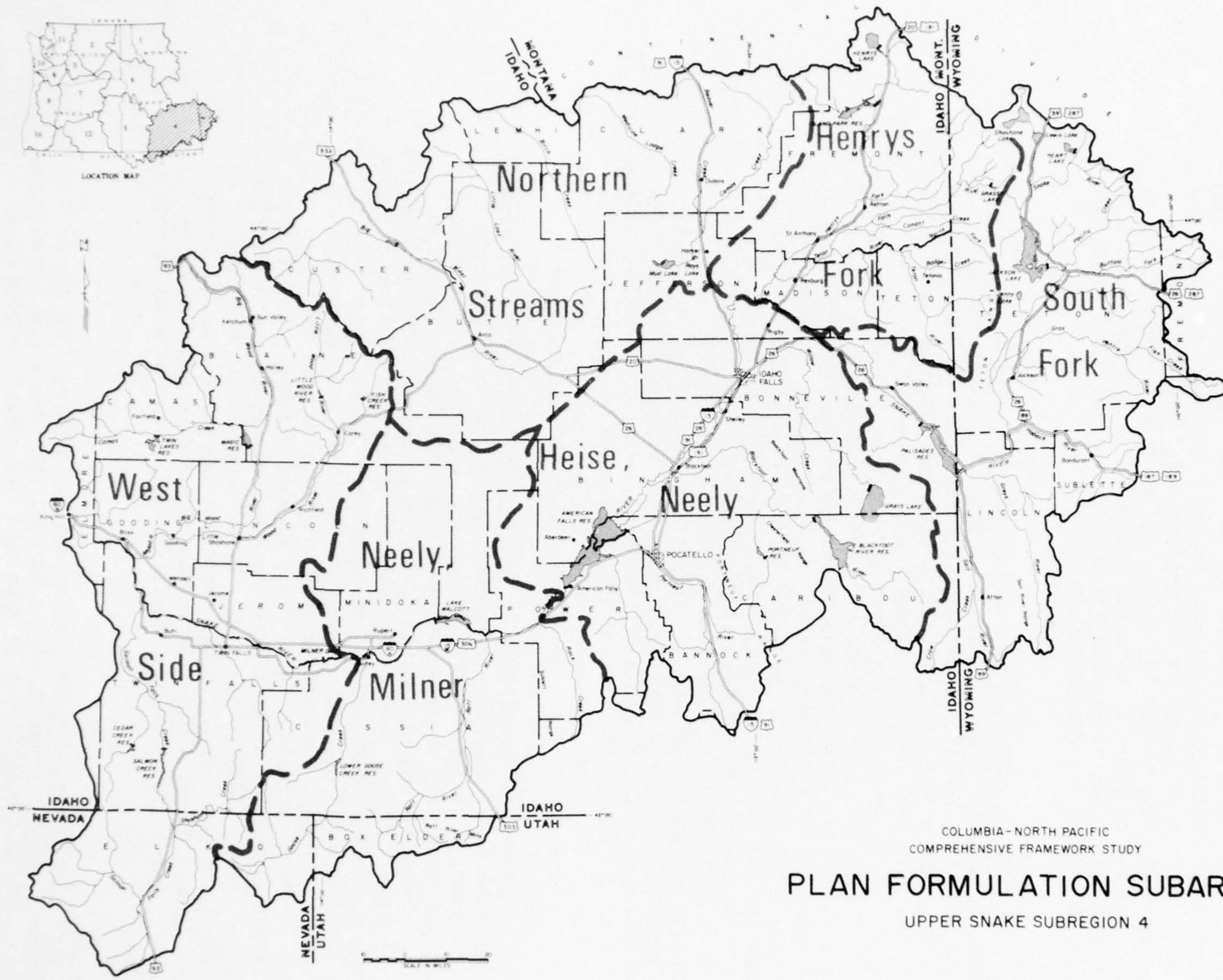
There are significant conflicts in the South Fork Subarea between construction of major storage facilities and preservation of natural environment. The major conflict centers around the

need for replacement of 640,000 acre-feet of Jackson Lake storage with either additional surface storage or increased ground-water use. This is discussed in the section, Main Stem Snake River. In general, large-scale irrigation and storage development would be bypassed in favor of recreational and environmental enhancement. Accordingly, most irrigation developments in the Snake River Area are considered for downstream areas.

1970 to 1980 Program The primary emphasis in the South Fork Subarea to 1980 would be to protect the environmental and related recreational potentials, determine long-range program needs, and, more specifically, identify means to meet these needs. During this time period, virtually all of the water and land resources would be left in their present state. The early action plan identifies only a minor amount of supplemental water for the 113,000 acres of inadequately irrigated land and no major development of new land. Flood plain zoning and 10 miles of channel and levee works would be key features of the plan for the Jackson Hole area. Levees would be offset to minimize adverse effects on the free flowing character of the stream. There are 310 miles of streams that have been identified as having recreation potential. This could involve perhaps 99,000 streamside acres for recreation use. The streams identified for study include all or parts of the Snake, Salt, Gros Ventre, Hoback, and Greys River. The free flowing reaches of the Snake and Gros Ventre Rivers above Palisades Reservoir have already been selected for study under section 5(d) of the Wild and Scenic Rivers Act.

Five small watersheds in Wyoming are included in the plan for cooperative management. Emphasis would be on better water conservation practices, stabilizing road cuts and stream channels, and improving the watershed through vegetative manipulation to reduce erosion and the resulting stream pollution. The early action program identifies only a minor amount of supplemental water for presently irrigated land and no major development of new land. Much of the 113,000 acres of water-short irrigated lands would receive special water conservation measures to make better use of existing water supplies. Waste treatment facilities for the large recreation-oriented loads and for municipal and industrial loads are included in the plan. Water supplies for both this recreation population and the municipal and rural-domestic needs would be provided through extension of existing systems and by pumping from ground water. Surface supplies may be used in some places.

Long-Range Program Plans for the 1980 to 2000 period include the construction of two multiple-purpose storage facilities on Crow and Spring Creeks in Wyoming. The effect of Crow Creek



COLUMBIA - NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

PLAN FORMULATION SUBAREAS

UPPER SNAKE SUBREGION 4

FIGURE 12

storage on the fishery in Idaho must be evaluated. Consideration should also be given to storage on Jackknife Creek in Idaho. With total storage capacity of 30,400 acre-feet, these would furnish water supplies for 1,200 acres of new irrigation and 29,900 acres of water-short land along Salt River. Consideration should also be given to major storage alternatives in Idaho or Wyoming of approximately 1,620,000 acre-feet to regulate flows on the Snake River for water use downstream, to help provide minimum flows for fisheries and water quality, to provide power generating capacity, and to provide much needed flood control. No major storage or irrigation development is contemplated for this subarea beyond 2000.

Water supply and waste treatment would be an extension of the 1970 to 1980 programs. Cooperative watershed management is planned for nine additional watersheds from 1980 to 2000 and for three watersheds from 2000 to 2020. The 1970 to 1980 management program would be expanded, but with more emphasis on erosion control and streambank stabilization. Water conservation activities would be a significant part of the 1980 to 2000 program.

As discussed in the section Main Stem Snake River, extensive pumping and recharge of the Snake Plain Aquifer and water savings programs could also be used in conjunction with new surface storage to help meet some needs in this subarea. These alternatives need to be studied before a plan for the Idaho portion of this subarea can be developed.

Henrys Fork Subarea (Subregion 4)

The Henrys Fork Subarea covers the northeastern tributary drainage in Idaho down to the confluence of the Henrys Fork and Snake River near Rexburg; it has scenic mountains in the eastern and northern portions with broad irrigated valley bottoms and dryfarmed rolling upland plains in the central and southwestern portions. Some 215,000 acres are presently irrigated and over 280,000 acres of dry land are potentially irrigable. However, large parcels of these lands are now used as migration routes or habitat for big game and other wildlife. Major storage sites are limited and are located in prime wildlife habitat areas. Moreover, Yellowstone and Teton National Parks are near this basin, enhancing the area for recreational and environmental purposes. Therefore, only a moderate amount of additional irrigation should be considered for this area. The major part of the water supply for irrigation will come from Teton Reservoir (now under construction on the Teton River), from natural flows in wet years, and from ground-water development. Additional water supplies could be provided by constructing three small reservoirs.

All of the reservoirs should be designed to serve recreation, fish and wildlife, and flood control purposes in addition to irrigation.

The average annual discharge of the basin is about 1.1 million acre-feet. Although the streamflow is fully committed to downstream users in dry years, there appears to be adequate flow to meet identified consumptive needs with proper control.

To fully control floods with storage, about 70,000 acre-feet of additional flood control space would be required on Henrys Fork above St. Anthony. An alternate measure would be to divert floodflows to the Snake River plain to recharge the aquifer. Another alternate would be to construct levees along the lower 5 miles of the Henrys Fork.

The quality of water in the basin's streams is relatively good, but some measures are necessary to insure its continued high quality. These would include municipal and industrial waste treatment and erosion control measures on cropland to stabilize or reduce silt loads in streams. Continued land treatment measures are needed on all lands. Problems include: erosion--about 182,600 acres, mostly cropland; wetness--44,200 acres; and flooding--34,000 acres. Cooperative treatment is needed on 19 watersheds. It is also important to protect the Snake Plain Aquifer from contamination if artificial recharge is practiced. Filtering and settling basins or similar measures may be required for this purpose.

The program developed for Henrys Fork Basin should focus on minimizing conflicts between environmental and developmental factors. Because the area has prime recreation potential, better management in handling water is necessary if storage developments are to be kept to a minimum. To help meet projected food and fiber needs, 60,000 acres of new land could be irrigated in the subarea, of which only 3,100 acres would require new storage. The three small storage facilities on Boone, Squirrel, and Teton Creeks, which would have minimal environmental conflicts, should be considered, primarily to furnish supplemental irrigation water.

Some 226 miles of streams have been identified as potential recreation streams. Included are portions of Henrys Fork, Teton, and North Fork Teton Rivers; and all of Warm River.

<u>1970 to 1980 Program</u> To assure an adequate supply of land and water for future use, measures have been included to protect and enhance water quality and the esthetic character of the basin. Some 65 miles of the Henrys Fork from Warm River to Big Springs have been designated for study under section 5(d) of

the Wild and Scenic Rivers Act. Acquisition of some 20,800 acres could be involved in developing a "greenbelt" adjacent to the streams. Other studies should also be made to determine requirements for managing scenic roads, lakes, reservoirs, and unique, natural, historical, and archeological resources.

Construction of a fish hatchery and 2 miles of artificial spawning channels should be considered for this period. These, along with spawning bed and stream improvement, nongame fish control in streams and lakes, and improvement of lakes, would do much to enhance the fisheries of this area. Wildlife management should consist of improving winter range in the foothill areas for both big game and upland game by providing adequate vegetative cover and fencing. Nesting facilities and feeding areas should be developed to enhance waterfowl population.

Construction of multiple-purpose storage on Boone and Squirrel Creeks with a total capacity of 10,000 acre-feet should be considered for this period. These could provide a full irrigation supply for 3,100 acres of new land, supplemental water to 3,000 acres, reservoir-related recreation, and flood control. Development of as much as 37,000 acres of new irrigation from surface water is now under study in the Teton area, primarily funded by the Federal Government. Another 20,000 acres is expected to be developed privately from ground water.

Flood control could be satisfied by the implementation of measures excluding major storage except that which is now under construction. Diversion of Henrys Fork floodflows above St. Anthony to a recharge area on the Snake River plain could both reduce flood damages and reserve the water in underground storage for later use downstream. In selecting recharge sites, consideration should be given to not affecting the sage grouse migration corridor between Quayles Lake and Hamer. Channelization and levee works along the lower 5 miles of Henrys Fork could reduce flood damages in the general area by more than half, but would eliminate recharge through adjacent wetlands used by waterfowl. This, along with the authorized storage facility on Teton River, could virtually eliminate flood damage on lower Henrys Fork. Local zoning of flood plains to restrict development near the towns of Teton, Sugar City, and Rexburg could help to minimize flood losses. Three multiple-purpose watershed programs should be included for this period with emphasis on erosion control and water conservation practices.

Organic waste removal efficiency of 85 percent could be secured through treatment of all municipal and industrial wastes. The effluent from the city of Rexburg now entering the South Fork of the Teton River should be transported to a land disposal area.

Assuming its continued good quality, there is an ample supply of ground water to satisfy all projected needs for municipal, industrial, and rural-domestic use in this area.

Long-Range Program By 1980, specific requirements for managing prime recreation should be defined. These plans could be implemented during the later time periods because both the short and long-range programs include studies of selected areas and streams aimed at their preservation. The long-range program for irrigation and storage should not encroach into these areas.

The program for the 1980-2000 period includes possible construction of a 3,600 acre-foot storage facility on Teton Creek to provide recreation and supplemental water for 3,400 acres of inadequately irrigated land. Ground-water pumping could supplement irrigation water supplies for 27,800 acres by 2000. A maximum area for big game winter range, upland game habitat, and for recreation could be preserved by refraining from development of any irrigation beyond that described in the 1970-1980 program. Cooperative development is programmed for seven watersheds from 1980 to 2000 and for nine watersheds from 2000 to 2020. As with earlier programs, emphasis should be on controlling erosion, conserving water, and cooperative land treatment, and protecting other environmental values.

Heise-Neeley Subarea (Subregion 4)

The southeastern half of the Heise-Neeley subarea is composed of high, rolling hills and broad valley bottoms; valleys to the east are prime winter wildlife habitat, but those in the western portion are highly developed for irrigation. The northwestern half includes a large irrigated area adjacent to the Snake River. Farther west are areas irrigated by pumping from the Snake Plain Aquifer. The western edge of the subarea is exposed lava beds and desert rangeland. American Falls Reservoir is located at the lower end of the subarea.

Although this subarea already has prominent irrigation, considerable potential for future expansion remains. Development of 226,800 acres of new irrigated land and additional water supplies for 53,800 acres of water-short land in this subarea by 2020 could help meet food and fiber requirements. Further study is needed to select these lands so that conflict with wildlife and environmental values is minimized.

Flows of the Snake River in this reach are substantial and are augmented in many months from upstream storage. However, the water is heavily committed, especially in dry years, to use here and in areas farther downstream. In wet years, however, a

large amount of water is available for additional uses. Flows in tributary streams cannot provide much, if any, water for new developments. There is an abundant supply of ground water in the area which could be used to fulfill needs.

An alternative to additional large surface storage in the upper part of the Snake Basin would be further use of the Snake Plain Aquifer as a storage reservoir. Whenever natural flows and existing storage fail to provide the necessary water supply, the needs could be met with ground water; when streamflows exceed requirements, the aquifer could be recharged to assure a continual supply. In order to recharge, facilities would be required in this subarea as well as in the Henrys Fork Basin. Water-saving opportunities on existing irrigation developments should also be considered.

This subarea has some of the greatest erosion problems in eastern Idaho, encompassing over 762,000 acres of mostly cropland. In addition, about 101,000 acres have wetness problems, and some 184,000 acres are subject to flooding. Cooperative treatment is needed on 20 watersheds.

Major population centers and industries at Idaho Falls, Blackfoot, and Pocatello discharge heavy waste loads into subarea streams. These communities and industries are taking steps to meet required levels of treatment. Return flows and runoff from lands above and adjacent to this reach of the Snake River add pollutants. Water quality problems are aggravated by a combination of heavy waste loads and seasonally diminished flows, particularly below Blackfoot.

Significant increases in requirements for municipal and industrial water in this area have been projected through the study period. These increases would stem from population growth and from the expansion of food processing and farm service industries. There is sufficient ground water to meet these needs and rural-domestic demands; however, quality could become a serious problem. Of major importance is the need to safeguard the Snake Plain Aquifer against pollution or contamination. Disposal of radioactive wastes at the National Reactor Testing Station should be accompanied by continuous monitoring to prevent contamination of the aquifer. Due to the limited filtering action of the strata overlying much of the area, contamination of the aquifer is a constant threat. Consequently, any artificial recharge plan would have to include filtering and settling basins.

Fewer opportunities exist to meet recreation and fish and wildlife needs in this area than in subareas upstream. However, several measures of importance should be considered in planning for these functions. The 53-mile reach of the Portneuf River

from its origin to Inkom and the 20-mile reach of the Blackfoot River from its origin to Blackfoot Reservoir have been identified as having potential recreational value. Also, sufficient minimum streamflow should be maintained to provide fish habitat and good water quality. Strategically placed wells could furnish these flows in dry periods and supply other requirements as well. There is a need to enhance the production of waterfowl and upland game by developing an exchange water supply of 7,400 acre-feet which would permit maintaining Grays and Market Lakes at constant levels. The presently authorized enlargement of Blackfoot Reservoir probably cannot provide the replacement water. Likewise, the possibility of pumping the replacement supply from ground water is doubtful, based on present knowledge of the area.

All water rights, including those of the Fort Hall Indian Reservation, must be considered in the planning for this subarea.

The programs being considered for this subarea are designed to minimize conflict. The expansion of irrigation, although considerable, could be designed so that it would not encroach into prime wildlife habitat. In the Henrys Fork and South Fork subareas, irrigation development was minimized because of environmental interests. Therefore, in order to assist in meeting food and fiber production requirements, it is desirable to include in the program consideration of a large block of irrigation development for the Heise-Neeley and other study areas downstream.

<u>1970 to 1980 Program</u> A 12,000 acre-foot storage facility at the Beacon Site on Bannock Creek could provide flood control, recreation, and irrigation water. With this storage, 1,900 acres of new irrigation could be developed and 600 acres of water-short irrigated lands provided a supplemental supply. An additional 13,000 acres could be developed from existing surface supplies in the Fort Hall area, and 150,600 acres could be supplied by ground water.

Channelization and offset levees along 4 miles of the Portneuf River near the towns of Bancroft and Lava Hot Springs could reduce flood damages; 4 miles of local protection works should also be considered on the Blackfoot River at Blackfoot. Recharge facilities in conjunction with zoning could reduce flood damages in this reach of the Snake River and at the mouth of the Blackfoot River. Filtering and settling basins, or more stringent measures, should be used in connection with the artificial recharge operations. Flood-plain zoning should be instituted in populated areas along Willow and Sand Creeks and Blackfoot and Portneuf Rivers. Ririe Dam, under construction on Willow Creek, will provide flood protection to Idaho Falls, Iona, Ammon, and surrounding farm land.

A combination of measures such as increased waste treatment, land treatment, erosion control, and flow augmentation should be considered for water quality purposes. Using ground water to irrigate new lands could also provide added summer flows and improve water quality in the Snake River below Blackfoot.

Cooperative land treatment should be considered on 1,074,600 acres in six watersheds. Emphasis should be on water conservation, erosion control, and flood prevention. Rangeland management at lower elevations should be to control livestock grazing through development of water supplies and construction of fences. In the foothills and at higher elevations, management should be concerned with protecting big game and upland game habitat and increasing its carrying capacity where possible. New irrigation developments should also include features to conserve and develop wildlife and fish resources.

Long-Range Program Consideration should be given to some 25 miles of channelization and levee works designed to have minimum adverse effects on fish. Modification of the 20 miles of existing levees in the Heise to American Falls Reservoir reach of the Snake River and an additional one mile on the Portneuf River in the vicinity of Inkom should be undertaken during the 1980 to 2000 period. These measures, in conjunction with flood plain zoning in the earlier time frame, would do much to minimize flood losses.

The possibility of providing an additional 74,200 acre-feet of storage capacity during 1980-2000 at three sites on Garden, Hawkins, and Marsh Creeks primarily to control floods should be considered. Storage at these sites in the Marsh Creek drainage would also provide some recreation and supplemental irrigation water for 6,200 acres. Ground-water pumping to irrigate 700 acres should also be included during this period. From 2000 to 2020, local ground-water pumping should be considered for 50,800 acres of new irrigation. Also, 9,800 acres of new irrigation and 47,000 acres of supplemental irrigation could be secured from storage, diversion from tributary streams, and exchange ground-water pumping.

Land treatment measures on nine additional watersheds between 1980 and 2000, and on five watersheds between 2000 and 2020, representing nearly three-quarters of a million acres, should be programmed. Water conservation and erosion control should be the dominant activities, but flood prevention and drainage improvement measures should also be continued. Management of grazing land and wildlife habitat discussed for the 1970 to 1980 period should be extended into the long-range program.

Neeley-Milner Subarea (Subregion 4)

This subarea covers the Snake River and adjacent areas between American Falls and Milner Dam. Burley is the principal town. This area is similar in characteristics to the Heise-Neeley subarea. The southern portion is composed of low mountains with broad valleys, an established irrigated agriculture adjacent to the Snake River, and recent lava flows in the areas to the north. These lava beds do not support any measurable surface flows, and the Snake River tributaries on the south are small and are mostly utilized before reaching the Snake River.

As noted under Main Stem Snake River, Milner Dam is an important diversion point, and the most downstream point in Subregion 4 from which gravity diversions can be made from the Snake River. Flows passing the dam average 1,545 cfs (about 1.1 million acre-feet annually) but fluctuate from large floods to almost nothing. Maximum flows are much in excess of current needs and, if regulated, could meet additional needs. Conversely, lack of minimum flows creates a critical situation instream, particularly in the Milner pool.

A high percentage of the irrigators have good natural flow and storage rights and generally receive adequate supplies. However, critical ground-water areas have been declared in the Raft River and Oakley Fan areas because of the declining ground-water levels. Adjacent to the developed lands are extensive areas of high quality land with good potential for irrigation development, but local water supplies are limited. In order to irrigate 268,700 acres of dry land, supplement supplies for 148,100 acres of water-short land, and meet instream Snake River requirements, it would be necessary to develop new water supplies from a combination of sources, including pumping excess natural flows and upstream storage releases available from the Snake River; pumping from Snake Plain Aquifer and local aquifers as recharge from new irrigation builds up local ground-water tables; saving water by lining canals in the adjacent irrigated areas to reduce losses; and developing new storage upstream. Conflicts could be minimized, particularly if irrigation developments provide features to enhance esthetic values.

Water quality problems are serious during the winter when streamflows are reduced by storage rights concurrently with heavy waste loadings. Although waste loadings could be reduced with treatment, winter flows would still need to be augmented. There is sufficient runoff in about two-thirds of the years to provide adequate minimum streamflows for water quality and also fill existing storage rights for the coming season. In the remaining years, water quality flows would preclude the filling of storage and encroach on the rights of existing spaceholders.

As discussed previously, alternatives considered for providing additional water include new storage on the Upper Snake River or its tributaries in Idaho or Wyoming, pumping ground water into the river, water savings, or a combination of these.

The 22-mile portion of the Snake River, from the confluence with Raft River upstream to American Falls Reservoir, was identified as having potential recreational value.

This subarea has serious erosion problems on about 838,000 acres of which nearly three-fourths are rangeland. Cropland has wetness problems on about 64,000 acres and local flooding on over 4,100 acres. Cooperative treatment is needed on 13 watersheds.

There may be some possibility of geothermal power development in the Raft River drainage.

<u>1970 to 1980 Program</u> Cooperative land treatment measures should be considered for two watersheds during this period. Most of the activity should deal with water conservation, streambank stabilization, erosion control, and drainage. Management on rangeland should consist mostly of controlled livestock grazing to enhance vegetative cover, including installation of additional watering facilities and fences. Upland areas and key wildlife winter range should be managed to enhance big game and upland game populations.

Developments by 1980 that could assist in meeting food and fiber needs could include irrigation of 61,200 acres in the Oakley Fan area using Snake River flows and storage supplemented by exchange ground-water pumping and local ground-water pumping. A supplemental supply could also be provided for about 81,500 acres in the Raft River area. Most of these large developments would probably be financed with public funds. An additional 25,000 acres are expected to be developed privately using local ground water. No major storage would be needed during this early time period. On the average, an additional 87,000 acre-feet of water should be provided annually from planned upstream developments to augment low flows below Milner Dam for water quality purposes. This quantity of water, along with treatment of all municipal and industrial waste to equivalent of 85 percent removal, would provide the required level of quality.

Flow requirements for water quality purposes could be maintained in the critical winter months in preference to filling storage rights. If runoff later in the year is sufficient to fill the storage space, all needs would have been satisfied by surface flows. In years when runoff and remaining storage are not adequate to fulfill entitlements, ground-water pumping could make up the

deficit. No additional ground-water installations would be needed to provide water quality flows, as the new irrigation wells could have sufficient capacity for these needs.

Long-Range Program An additional 11 watersheds should be considered for cooperative land treatment practices during the 2000 to 2020 period. Most of the emphasis should be on controlling erosion (325,000 acres). Considerable area should also receive flood prevention, drainage, and a small amount of water conservation measures. However, most of these activities should be for water conservation. Livestock and wildlife management practices discussed in the 1970 to 1980 program should continue into these periods.

The irrigation program from 1980 to 2020 could include development of 182,500 acres of new land and furnishing supplemental water for 66,600 acres of water-short land. Nearly all (180,500 acres) of the new development and most of the supplemental irrigation would be in the Raft River area utilizing a combination of natural flows, existing storage on Snake River, and ground water; about 106,000 acres of this new irrigation should come in during the 1980 to 2000 period. Alternative means of providing additional irrigation development during the 1980 to 2000 period include 7,000 acre-feet of storage on Rock Creek--500 acres plus supplemental supply for 3,200 acres; 12,100 acre-feet of storage for 16,900 water-short acres in four small reservoirs on the Raft River drainage; and by diversion or pumping from Snake River to irrigate 1,500 acres of new land. New storage, if developed, could provide some recreation and flood control as well as furnish late-season irrigation water.

An additional 43,800 acre-feet of water to augment low winter flows at Milner Dam could be provided in the 1980 to 2000 period; between 2000 and 2020, an additional 47,000 acre-feet should be provided. These supplies could come from the Snake Plain Aquifer through joint-use pumping.

Northern Streams Subarea (Subregion 4)

This subarea, which forms the northern boundary of the Upper Snake Subregion, extends west from the Henrys Fork drainage to include the Big Lost River drainage. It is composed of picturesque mountain ranges with broad valley bottoms in the northern portion, rugged timber-covered mountains in the west, and desert range land with lava flows to the southeast. Numerous small streams, which originate in the mountains, sink into the lava beds of the Snake River Plain. These and other flows feed the Snake River Plain Aquifer and contribute to the large outflow of Thousand Springs.

Lands located along these northern streams are heavily irrigated in the early part of the growing season; but because storage is lacking, most of the irrigated lands are water-short in the latter part of each season. Frequent flooding during spring runoff causes extensive damage to lands, buildings, railroads, irrigation facilities, and other improvements. Three small reservoirs at strategic locations on Gordon, Antelope, and Camas Creek could provide storage for irrigation, flood control, fish, wildlife, and recreation.

A number of other measures would assist in effectively managing the land and water resources. There are nearly 114,000 acres (about 60 percent rangeland) needing erosion control, nearly 18,000 acres with wetness problems, and almost 28,000 acres of cropland subject to local flooding. Cooperative watershed treatment is needed on eight watersheds.

Some opportunities exist for enhancing resources to meet fish, wildlife, and recreation needs. About 73 miles on Medicine Lodge Creek and Big Lost River are important for recreation purposes. This subarea also contains important wildlife habitat and migration routes. In recognition of these needs, new irrigation should be limited to protect these important wildlife areas. Small reservoirs could provide supplemental late-season water and a full supply for small bodies of interspersed new lands. Local ground-water pumping is increasing, and this expansion is assumed to continue for both supplemental supply and new land development. It is also assumed that the larger blocks of land on the fans of Medicine Lodge Creek and Birch Creek could be irrigated from ground water. Total irrigation development considered for this subarea includes a water supply for 36,700 acres of water-short land and 100,500 acres of new land.

The small municipal and industrial water requirements could be provided from ground water, the quality of which is generally excellent. There are no known major water loads in this subarea, but adequate treatment must be obtained for those that are produced in order to maintain the high water quality. Land treatment and erosion control practices to check rapid runoff and flooding would also reduce pollution from agricultural wastes and help maintain high stream quality.

The program for the northern streams could result in a few conflicts, the major one being that associated with the need for 12,000 acre-feet of storage on Medicine Lodge Creek above Middle Creek. This 27-mile stream has been identified as having potential recreation value. Development of storage here should be considered in the long-range program and a study provided in the early time frame to examine alternatives available to help meet supplemental irrigation water needs.

AD-A036 571 PACIFIC NORTHWEST RIVER BASINS COMMISSION VANCOUVER WASH F/G 8/6
COLUMBIA-NORTH PACIFIC REGION COMPREHENSIVE FRAMEWORK STUDY OF --ETC(U)
JUN 72 E J GULLIDGE, H H RALPHS, C STEWART

UNCLASSIFIED NL

4 OF 7
AD
A036571

1970 to 1980 Program Storage of 24,000 acre-feet on Birch Creek would provide irrigation and some recreation but no significant flood control. With this storage, 6,500 acres of new irrigation could be developed and 2,200 water-short acres furnished a supplemental supply. Ground-water pumping could also be included to irrigate some 15,000 acres on the Medicine Lodge Fan, 12,000 acres in the Mud Lake area, 9,000 along the Big Lost River, and 13,000 acres of dry land plus water for 13,500 water-short acres along Little Lost River.

The flood problems in the Mud Lake area could be partially solved during this period by raising and strengthening 9 to 12 miles of existing low dam along the west and south shores of Mud Lake and on lower Camas Creek and improving diversions into the lava beds.

Livestock management through close supervision of grazing should receive major emphasis on public grazing land. Associated development should include additional watering facilities and fencing. Other land treatment practices should include erosion control primarily through vegetative cover manipulation, water conservation, and drainage. Four small watersheds in Big Lost River drainage should be included for treatment during this period.

Long-Range Program During the 1980 to 2000 period, two storage facilities with a total capacity of 20,000 acre-feet could be developed on Medicine Lodge Creek above Middle Creek and Antelope Creek at the Lower Antelope site to furnish 21,000 acres with a supplemental irrigation water supply. These could present major conflicts, however, as they would inundate several miles of stream with high recreational value. For the 2000 to 2020 period, 45,000 acres of new irrigation could be developed by using local ground water in the Birch Creek Drainage.

Cooperative land treatment measures should be considered on four watersheds during the 2000 to 2020 period. Activities should be primarily associated with improving irrigation practices to conserve water, providing erosion control and reducing flood damages. The long-range program for management of public lands should be an extension of the 1970 to 1980 program.

West Side Subarea (Subregion 4)

The West Side Subarea, forming the western boundary of the Upper Snake Subregion, includes tributary drainage areas north and south of the Snake River between Milner Dam and King Hill. Twin Falls is the major population center. This subarea is one of marked contrasts which weigh heavily in planning considerations.

The part south of the Snake River, which has many acres of high quality land and excellent climate for agricultural production, is quite arid, and water supplies are very limited. The Snake River, which is often depleted in summer months at Milner Dam, is replenished by Thousand Springs in this reach. However, to reach the main bodies of choice land southwest of Twin Falls with water from the Thousand Springs area would require pump lifts of 500 feet or more and extensive canal systems. Small bodies of land near the river are being developed by river pumping, and some extension of irrigation by this method is expected to continue.

North of the Snake River are extensive, highly developed irrigated agricultural lands that are generally well supplied with water from storage and natural flow of Big and Little Wood Rivers and Snake River and by pumping from the Snake Plain Aquifer near Thousand Springs. Increased ground-water pumping could provide an exchange supply for water-short land south and west of Twin Falls, but specific well fields have not been identified in the framework study. Additional irrigation water supplies for 67,700 acres of dry land and 69,700 acres of water-short land could help meet food and fiber needs.

The northern part of this subarea, encompassing the famous Sun Valley resort area and portions of the Sawtooth and Challis National Forests, is very scenic and affords many excellent opportunities for recreation development. It is close enough to major population centers in Idaho to fulfill significant portions of projected local needs. The attractiveness of the area also draws tourists from distant points. It supports a wide variety of wildlife and has numerous clear, cold streams and small lakes that support trout fishing and other recreational pursuits.

The larger streams draining the alpine areas have some storage important for irrigation, flood control, recreation, fish, and wildlife. Four additional small storage reservoirs are needed for supplemental irrigation and flood control in Nevada; two others should be considered in Idaho. These could be placed so as not to detract from the recreational use of much of the area. Some 87 miles of streams in the subarea have been identified as having high recreation potential.

This subarea also has a major erosion problem involving 838,000 acres of mostly rangeland. Cropland problems include 55,000 acres with wetness and 70,000 acres with local flooding. Cooperative treatment is needed on 22 watersheds.

Implementation of measures described for the Neeley-Milner Subarea could correct problems associated with low flows and heavy waste loadings which sometimes cause poor water quality in the stretch of Snake River immediately below Milner Dam. The

quality of Snake River flows is improved rather rapidly by inflow from Thousand Springs and becomes very high by the time the river reaches King Hill. Some build-up of water quality problems could occur in tributary streams without adequate waste disposal and control of runoff. Proper treatment of wastes, together with land treatment, erosion and flood control measures, is needed to prevent serious water quality problems.

Municipal and industrial water supplies for Twin Falls and others in this subarea can be provided from ground water.

The plans and programs identified for the West Side Subarea would have minimal conflicts. The picturesque region to the north would be virtually unchanged in terms of esthetic values. Offset levees could be used for flood control where channelization would destroy fish and wildlife habitat. Storage facilities could be located in areas where environmental impact would be limited. The additional irrigation would, for the most part, be extensions of present blocks of irrigation. Development of irrigation and storage facilities could assist in meeting future food production requirements, as well as other needs.

1970 to 1980 Program Some 87 miles of stream were identified in the study as having recreational value. Associated with this would be the acquisition and enhancement of some 28,000 adjacent acres. During the early time period, activity would primarily be to acquire land for public access; the long-range programs would deal with their enhancement. Potential recreation streams identified are the Snake River below Twin Falls, Big Wood River above Magic Reservoir, North Fork of Big Wood River, and all of Silver Creek.

Channelization and levee works should be considered for 24 miles along the Big and Little Wood Rivers. Because of possible environmental conflicts in the upper reaches of Big Wood River, offset levees, a minimum of channelization, and heavy reliance on zoning should be considered to keep environmental, recreation, fish, and wildlife losses at a minimum.

Development of 67,700 acres of new irrigated land and furnishing additional supplies to 49,400 water-short acres should be considered. The supplemental irrigation, all south of the Snake River, could be served from Snake River storage supplemented by exchange ground-water pumping and local ground-water pumping. Irrigation for 44,700 acres, primarily in the Salmon Falls and Deep Creek areas, could be supplied from the same sources. Water for the remaining 23,000 acres of new development in the Belle Rapids area south of the Snake River and west of Salmon Falls Creek could be pumped from existing flows of the Snake.

Cooperative land treatment is needed on five watersheds, with the major emphasis on erosion control, water conservation, and drainage. Management of the mountainous area to the north should involve considerable erosion control through vegetation manipulation and stabilizing roadcuts and streambanks. Legislation should be considered to control mining activities so that contamination of streams would not be excessive. Management of rangeland should involve controlled livestock grazing, through development of water supplies and fencing.

Long-Range Program Land management activities of the early time frame could be expanded with considerably more emphasis on erosion control, water conservation, drainage, and flood prevention practice. Structural as well as nonstructural measures could be used. Cooperative treatment is needed on eight watersheds by 2000 and on an additional nine watersheds by 2020. Emphasis should be on key wildlife habitat acquisition and management.

The plan for 1980 to 2000 would include additional units at the existing Bliss and lower Salmon powerplants and construction of four small reservoirs in Nevada, and consideration of two more in Idaho with a total capacity of 8,500 acre-feet. They would provide some flood control, recreation, and supplemental irrigation water. The four planned for Nevada would supplement supplies for about 2,300 irrigated acres; the two considered north of Snake River on Clover and Calf Creeks could provide water for about 3,000 water-short acres. An additional 15,000 acres in the Big Wood River drainage should receive supplemental ground water by 2000. No new irrigation was planned in Nevada or considered in Idaho for the 1980 to 2020 period, nor has a feasible means been devised of providing full supplies to the remaining water-short lands.

Bruneau Subarea (Subregion 5)

The Bruneau Subarea, shown in figure 13, includes the Bruneau River Basin and small southside Snake River tributaries northwest of the Bruneau drainage, including Succor Creek. It is characterized as a broad-sage-covered, gently sloping land mass, dissected by several deep canyons which are particularly picturesque at higher elevations. This area also has one of the greatest potentials for helping to meet the region's future food production needs yet it is so expansive that the opportunities for recreation and wildlife enhancement are outstanding. The main hindrance to development is a lack of water. The many scenic features include the Bruneau Sand Dunes, Bruneau-Jarbidge Canyon, and the Jarbidge Mountains and wilderness, located in the headwaters of the Bruneau and Jarbidge Rivers. Because of its natural attributes, the entire main stem of the Bruneau River in Idaho is

being studied under the National Wild and Scenic Rivers Act. The Bruneau River drainage includes a large area of strategic winter deer habitat.

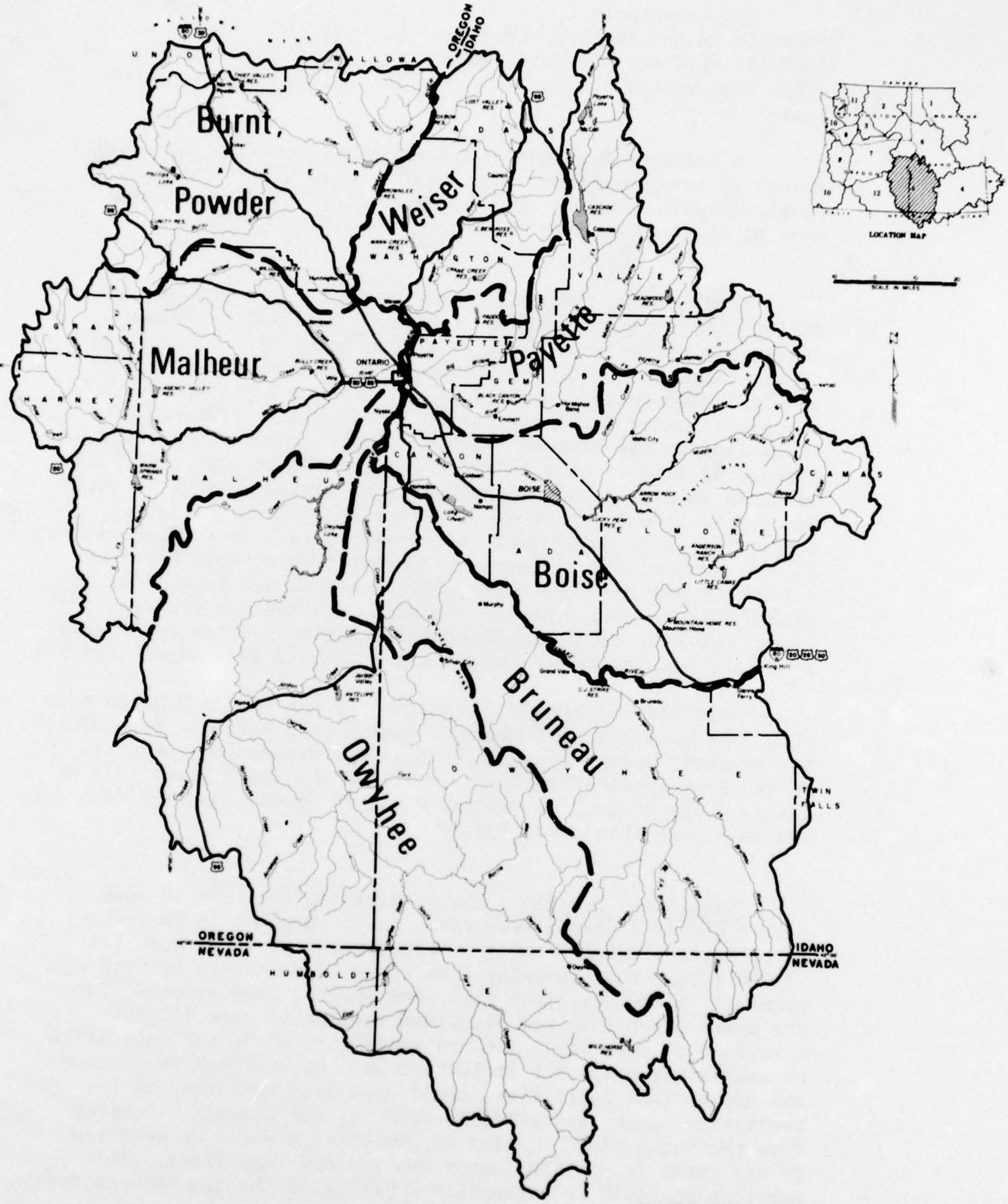
Runoff of the subarea is erratic, resulting in late season water shortages every year and flood damages to agricultural land roads and other facilities in the early part of some years. Normally, summer flow in the Bruneau River is warm, high in sediment and dissolved solids, and contains a high fluoride concentration.

The Grand View area has significant domestic water quality and pollution problems. This small community obtains its supply from ground water and disposes of part of its wastes underground where domestic systems can pick up the contaminated water. The presence of feedlots in the area complicates the problem.

There are more than 1 million acres of potentially irrigable land in the subarea. The Bruneau River is not a likely source of water because of its relatively small available supply, deep entrenchment, and possible designation as a wild river; other local tributaries contribute only small amounts of usable runoff. More than 400,000 acres of lands on the Bruneau Plateau are less than 600 feet above the Snake River making it the most likely source of irrigation water. However, to irrigate any sizable acreage would require substantial storage either on the Snake River or at offstream sites on the plateau. The pumps required to lift the water approximately 500 feet into the off-stream storage would likely operate year around to save surplus flows of the Snake and to minimize the size of the pumps. Summer pumping would supplement storage water and thus reduce the size of the storage required. Other alternatives include: (1) continued expansion of direct river pumping to adjacent lands, (2) exchange ground-water pumping from the Snake Plain Aquifer upstream, (3) transbasin diversions from the Boise and Payette Rivers, (4) a long canal from Milner Dam, and (5) pumping local ground water.

About 10,000 acres of irrigated land along Succor Creek have insufficient late season water. In addition, floods damage agricultural lands along intermittent reaches of the stream, especially in the lower 5 miles. About 15,000 acre-feet of storage upstream could provide the needed supplemental water and reduce flood damages by about 90 percent.

Constant and continuing treatment is badly needed on all land in the subarea. Problems needing attention include: erosion, nearly 1,743,000 acres; wetness, 61,600 acres; and local flooding, 8,700 acres. Cooperative land treatment is needed on 23 watersheds.



COLUMBIA-NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

PLAN FORMULATION SUBAREAS

CENTRAL SNAKE SUBREGION 5

FIGURE 13

Single-purpose flood control storage does not appear feasible in the subarea because of limited benefits and major conflict with environmental interests. Flood plain zoning and other nonstructural measures could be used to minimize flood losses.

In order to help meet food and fiber needs, a significant amount of new irrigation could be developed in this subarea. Conflicts with wildlife could be minimal if sufficient areas are set aside to compensate for any wildlife losses.

1970 to 1980 Program Activity in the Bruneau Subarea during this early time period would, for the most part, be restricted to the area adjacent to the Snake River. Programs to be considered include cooperative land treatment practices on eight watersheds primarily to control erosion. Livestock management under a closely controlled grazing system could be emphasized on the Bruneau Plateau. Also, wind erosion could be reduced by establishing additional vegetative cover. Spraying of dense sage areas and reseeding with crested wheatgrass could be deemphasized in favor of livestock management. These activities would complement the private development of an estimated 58,000 acres of new irrigation adjacent to the Snake River by direct pumping from the river (50,000 acres) and from local ground water (8,000 acres). The plan includes new storage on Succor Creek to supply supplemental irrigation water for 10,000 acres and provide flood control and reservoir recreation benefits.

Wildlife enhancement potential for the entire Bruneau area should be more precisely defined during this period. In addition to the study being made to determine the recreation potential of the Bruneau River in Idaho, parts of the Snake River, all of the Jarbidge River, the Bruneau River in Nevada, and the Jarbidge Mountain area should be studied.

Long-Range Program The program for the 1980 to 2020 period should consider developing water supplies to irrigate an additional 340,000 acres. Ground water could be used for 58,000 acres; the remaining land could be developed by pumping primarily floodflows (but with some pumping year around) from the Snake River into new offstream storage of some 500,000 acre-feet of capacity. The new reservoirs could not only serve as regulating pools for irrigation but, with proper regulation and appropriate facilities, could also help meet many of the recreation, fish, and wildlife needs of the subarea. Pumping from the Snake Plain Aquifer in Subregion 4 would be required in dry years to maintain water quality and fish flows. This development could be accomplished primarily through Federal funding.

Major land use conflicts with big game and sage grouse could develop. However, with proper planning and zoning the prime wildlife area could be bypassed in the development of the area for irrigation. Cooperative watershed treatment and management practices for five watersheds in the 1980 to 2000 period and 10 watersheds for 2000 to 2020 should be considered. Much of the activity could be accomplished concurrently with irrigation development to increase irrigation efficiency and reduce surface erosion and thus the detrimental effects of irrigation return flows. Management activities on public lands should be accelerated with particular emphasis on controlling livestock grazing and protecting the key winter deer range.

Boise Subarea (Subregion 5)

The Boise Subarea consists of the Boise River drainage plus the area south and east to the Snake River, including the Mountain Home Plateau. The northeast section is forested mountains, providing an abundance of recreational potential and water. The area downstream from the city of Boise contains a highly developed irrigated agriculture economy with only limited potential for further expansion. The desert area between Boise and the Snake River to the southeast has lands capable, with irrigation, of providing a significant contribution to the region's future food production needs.

Natural flow of the Boise River, supplemented by about a million acre-feet of storage in Anderson Ranch, Arrowrock, Lake Lowell, and Lucky Peak Reservoirs, supplies water to over a third of a million acres. These reservoirs also afford the Boise Valley significant flood control, reducing average annual damages from over $2 million to about $100,000. The free flowing stream segments and the existing reservoirs in the upper basin provide a favorable mix of water-oriented recreation opportunities. Lucky Peak Reservoir is the most heavily used by recreationists, receiving over one million visitor days use in 1969.

Boise River, the most highly developed stream in Idaho and traversing a rapidly growing area, needs an integrated study to determine the adequacy and optimum use of water resources and control facilities. Complete control of the Boise River could be accomplished by providing 600,000 acre-feet of storage on the Middle Fork at the Twin Springs site. Although this amount of storage would create a 14,000-acre lake, it would inundate 21 miles of stream with high recreation potential and 4,500 acres of big game winter range. There is also local opposition to a reservoir on the Middle Fork. The storage would reduce flood damages in the Boise Valley, meet water quality flow requirements in the river at Boise in most years, and permit hydropower production at-site and at Lucky Peak Dam.

A serious water quality problem exists in the basin below Boise, where at times streamflow consists almost entirely of return flows and municipal waste water from the Boise area. Feedlot drainage also contributes turbidity, dissolved solids, and bacterial contamination. Flow stoppages every 2 or 3 years for maintenance work on the Lucky Peak Dam outlet and irrigation diversions have added to the problems. Recent improvements in waste treatment have decreased to some extent the adverse effects of these wastes on the river. However, game fish production has been curtailed, and recreational opportunities and esthetic values have been reduced in and along the lower Boise River. Treatment and control of return flows below Boise would be necessary to achieve satisfactory water quality in the lower Boise River. Minimum flow requirements for water quality in the Boise River at Boise, currently estimated at 113 cfs, were estimated to increase to 190 cfs, 240 cfs, and 330 cfs in the future time periods even with the adopted levels of waste treatment.

This subarea also has major erosion problems involving over 1,558,000 acres. In addition, 55,700 acres have wetness problems and 8,400 acres of upstream lands are subjected to local flooding. Cooperative land treatment is needed for 18 watersheds.

Although reservoirs substantially control the Boise River, the lower valley still incurs average annual damages of about $100,000, which are projected to triple by 2020. In addition, four critical sidehill tributaries on the north side of Boise cause extensive flood damage to residential properties amounting to about $113,000 annually. These damages are expected to increase to almost $1,069,000 by 2020 if they are not stemmed by zoning or other means. A greenbelt from Lucky Peak Dam to the mouth of the Boise could solve flood damage problems through zoning and offset levees, provide much needed recreation and wildlife areas, and eliminate cattle feedlot and septic tank effluent from the river.

The Boise River Basin and the Mountain Home Plateau have about 90,000 and 500,000 acres, respectively, of potentially irrigable land. About 70,000 acres in the Boise Basin along Willow Creek could be served from either the Boise or Payette Rivers. The Payette River is the more likely source due to the high existing use of the Boise River. Irrigation water for the Mountain Home Plateau is proposed through water exchange arrangements using Payette, Boise, and Snake Rivers.

The retention of the scenic mountainous area for its environmental and recreational values was of prime concern while the best use of the desert was considered to be to help meet food

production needs. Water-related recreation needs in the vicinity of population centers was also recognized. Conflicts exist in both areas--storage vs. preservation in the mountains and irrigation development vs. wildlife habitat on the desert. Measures should be taken to preserve prime recreation and wildlife areas and further study is proposed for other areas to determine the best use of the land and water resources.

1970 to 1980 Program During this period a comprehensive study of the entire Boise River system should be conducted to determine which free flowing reaches should be maintained for their value to recreation, fish, and wildlife, and where major water storage developments should be made. Hunting and fishing access should be secured and roads built to selected areas, big game winter range should be improved and protected, and specific endeavors such as establishment of Kokanee salmon in Anderson Ranch Reservoir should be undertaken.

Local flood protection should be considered for the 50 miles of the Boise River from the city of Boise to the river mouth. Offset levees with a minimum of channel alterations could be used to minimize detrimental effects on wildlife and fish. Single purpose flood control detention dams on Cottonwood Creek and Stuart Gulch, with a combined capacity of 4,900 acre-feet, are needed by 1980. Flood plain zoning and other nonstructural measures should be considered for Hulls and Crane Gulches. Measures for the Boise National Forest should include establishment of better vegetative cover for wildlife and control of erosion and reduction of stream sedimentation. Forest land management activities should be primarily associated with logging and the enhancement of recreation and wildlife; stabilizing road cuts and stream channels would be particularly important.

Adequate treatment should be provided for all municipal and industrial wastes. Fences, retaining structures, and other measures should be installed to prevent livestock wastes from entering the lower Boise River. A study is needed to determine necessary minimum flows of the Boise River at Caldwell to provide satisfactory water quality.

Municipal, industrial, and rural-domestic water supply needs could be met through expansion of existing systems and by pumping from ground water except for the Boise metropolitan area where ground water quality conditions are forcing consideration of a surface water supply. A study would be made of the urban water problems in this area which are becoming more serious and complex with growth. A plan for handling these problems would be developed.

Irrigation of 197,000 acres could be accomplished by a water exchange involving the Payette, Boise, and Snake Rivers. Part of the Mountain Home Plateau would be developed by diverting water from the South Fork of the Boise River for use on the Mountain Home Plateau. Boise River water would be replaced by pumping from the proposed Swan Falls-Guffey project. The remainder of the projected development could be served by importation of Payette River water or possibly by a ground water pumping exchange. The Guffey-Swan Falls development could provide power and recreation in addition to reduced lift for irrigation pumping. The new power installation would be 186 megawatts, but the project would eliminate an existing plant with an installed capacity of 10 megawatts. Studies will continue on the Twin Springs multiple-purpose development.

Watershed protection and land management practices should be considered for one watershed during this period. Special emphasis should be given to controlling erosion and improving water management practices on one-third million acres of irrigated land. Involved should be conversion to more efficient sprinkler systems, construction of drains, and expansion of programs such as deep plowing to improve the productivity of the land.

Long-Range Program With the large population and economic growth expected in the lower Boise Valley, water quality and flood problems will become even more critical. Cooperative treatment should be considered on nine watersheds during the 1980-2000 period and on eight watersheds during the 2000-2020 period. Erosion control of the Boise foothills and the forested regions should be a major long-range effort in watershed management. Improved irrigation practices could be initiated on much of the irrigated land.

Crane and Hulls Gulches detention dams should be considered for construction in the long-range program to control occasional flooding in Boise. An extension of the 1970-1980 plan could add 95,000 acres of new irrigation on the Mountain Home Plateau. If found to be feasible and locally acceptable during the early time frame, the Twin Springs multiple-purpose development would be installed.

Payette Subarea (Subregion 5)

The Payette Basin can be characterized as a picturesque, wooded, mountainous region dissected by large rivers flowing in long, narrow valleys. The scenic beauty of this drainage basin makes it a recreational paradise. Small glacial lakes dot high mountain meadows while several manmade lakes cover significant portions of the mid elevation bottom lands. Waters of the Payette are generally clear, cool, and of high quality. The Payette River from Black Canyon Reservoir upstream to the forks and the free flowing segments of the North and South Forks provide an aggregate of about 150 miles of prime recreation streams. The lower Payette River below Black Canyon Dam supports an important Canada goose nesting population.

Within the basin, about 80 percent of the 150,000 acres of irrigated land are adequately supplied. Flood damages are confined parimarily to the lower Payette Valley that extends from Black Canyon Dam to the river mouth. However, flooding occurs in the Montour Valley from backwater of Black Canyon Reservoir during high runoff periods. Present average annual damages in the basin, $41,000, are estimated to increase by over 2.5 times by 2020, if they continue unchecked.

Municipal waste treatment practices in the basin need to be improved. Significant waste loadings are released to the Payette River at Emmett and waste treatment facilities are either inadequate or nonexistent at McCall, Donnelly, and Cascade, Idaho.

This basin has 950,000 acres with erosion problems, 18,400 acres with excessive wetness, and 32,300 acres of upstream land with local flooding. Nine watersheds should be considered for cooperative land treatment and watershed protection to provide optimum use of the land and water resources in the subarea.

Most of the 130,000 acres of potentially irrigable lands in the basin are located on tributary streams where land quality and climate severely limit their productivity. A partial alternative for meeting irrigation needs would be an exchange involving ground water pumping in the Boise Basin. An alternative for using Payette River water for additional irrigation involves diverting it to the Boise River Basin. This exchange is discussed in the Boise Subarea writeup. Key to this proposal is the 2.4 million acre-feet of new storage which could be provided at the Garden Valley site located on the South Fork of the Payette near its confluence with the North Fork. In addition, this storage could, in conjunction with existing reservoirs, regulate a standard project flood to bankful capacity (12,000 cfs) at Emmett. Channelization and a greenbelt with levee works at intervals along the lower 38 miles of the Payette River would be an alternative to storage for reducing flood damages.

Certain negative environmental effects would result from construction of additional storage or channelization and levees. Garden Valley Reservoir would inundate about 35 miles of forested stream and critical big game habitat. Considerable habitat would be lost with channelization and levee works along the Payette River. Adverse environmental effects could be minimized by the use of offset levees and provisions for a greenbelt for wildlife habitat between the streambank and the levees. Development of storage facilities and the use of Payette River water is the key to meeting projected water needs in southern Idaho, but they must be weighed against effects on the environment.

1970 to 1980 Program Cooperative land treatment should be considered for two watersheds. Land management would deal significantly with enhancement of recreation and wildlife. Special emphasis should be given to minimizing stream sedimentation from logging, road building, and mining operations to preserve the esthetic value of the area. Adequate vegetative cover could also be established to provide erosion control and feed for wildlife and livestock.

To assist in meeting projected irrigation needs in this early time period, it would be possible to construct 2.4 million acre-feet of storage on the South Fork at the Garden Valley site. This storage could provide sufficient water to irrigate lands in the Payette drainage and on the Mountain Home Plateau on a water exchange basis (see Boise Subarea) and could afford significant flood control along Payette River. Hydroelectric power could be generated at Garden Valley and at several locations on Scriver Creek, which could be used to carry North Fork Payette water into the storage reservoir. Additional power development from reregulation of releases and pump-back storage should be explored for development. Construction of these facilities would conflict with timber, recreation, and wildlife interest. In addition, 62,000 acre-feet of storage could be constructed on Gold Fork for flood control, recreation, and irrigation. About 10,000 acres of new land and 28,000 acres of water-short lands could receive full irrigation supplies from Gold Fork and other existing water sources in the upper Payette. In addition, some 67,000 acres of new land on the Willow Slopes areas in the lower basin could be irrigated primarily from existing reservoirs.

Flood plain zoning is needed for the Payette River in the vicinities of Payette, Emmett, and Horseshoe Bend. A study to determine the feasibility of a greenbelt should also be initiated during this period. Water supplies for municipal and industrial, as well as rural-domestic use, would come from ground water. New waste treatment facilities or improvement of existing facilities at Emmett, McCall, Donnelly, and Cascade should also be provided.

Long-Range Program Programs identified to meet 1980 water quality needs should continue. The treatment levels of municipal and industrial wastes and the streamflow requirements to meet future water quality and fishery needs should be accomplished. Land treatment measures identified for the 1970-1980 period should be continued with emphasis in the Payette drainage on erosion and sediment control, streambank stabilization, and water conservation. Cooperative treatment should be carried out on four watersheds between 1980 and 2000 and on three watersheds between 2000 and 2020. The fish, wildlife, and recreation potentials should continue to be protected and developed, with emphasis on the Payette Basin to meet many of these needs for the surrounding areas.

Weiser Subarea (Subregion 5)

The Weiser Basin is a rolling upland and mountainous area having narrow valleys with strips of farmland near streams. The wooded mountains are very scenic and wildlife is abundant. In the upper basin, large irrigation diversions are made when streamflows are available; the return flows are subsequently used for irrigation downstream. Existing small reservoirs are insufficient to meet all the water supply and flood control requirements, and quality of the river water is low. Excessive turbidity during runoff periods and high temperatures due to reduced flow resulting from diversions preclude a significant fishery.

Most of the better quality lands that could be irrigated with rather simple diversions have already been developed. The bulk of the remaining 100,000 acres of potentially irrigable lands are located on plateaus above the river and would require extensive diversion schemes or pump lifts. Many of these lands would require sprinkler irrigation because of topographic relief.

Several storage possibilities exist in the basin, but the most promising are enlargement of the existing Lost Valley Dam and new offstream storage at the Monday Gulch site or at the Tamarack site on Weiser River at its confluence with Mosquito Creek. The Lost Valley enlargement or storage at the Tamarack site could supply water to lands in the vicinity of Council; the Monday Gulch site could supply lands around Cambridge and Midvale. An alternative for both of these new sites would be a 250,000 acre-foot reservoir on the Weiser River near Goodrich. However, this site would have high right-of-way and relocation costs and could be detrimental to streamside recreation.

Existing storage has reduced average annual flood damages from $122,500 to $95,000. It is estimated that increased

development will cause these to increase to $230,000 by 2020 without additional protection or adequate flood plain management. Most of the remaining damages occur in and near Council, Cambridge, Midvale, and Weiser, Weiser being the largest problem area. Enlargement of the existing Lost Valley Reservoir could contribute to the control of high flows; however, it appears that channelization and levees are the most feasible structural measures for significantly reducing damages. Such work could effectively reduce damages on the lower 13 miles of the river and at Cambridge and Midvale. To eliminate the adverse effects of channelization and levee works, setback levees could be used. Flood plain zoning should be implemented immediately to assist in keeping future damages at a minimum; a greenbelt along the lower 13 miles and through all upstream towns could offer recreational opportunities.

Inadequate septic tanks at Cambridge contribute to water quality problems in the Weiser River. This situation should be corrected with a collection system and treatment plant. Also, high summer water temperatures present a water quality problem. A significant portion of the upper watershed area needs land treatment and watershed protection measures to provide optimum use of the land and water resources. There are over 821,700 acres with erosion problems, 16,800 acres with excessive wetness, and 15,000 acres of upstream land with local flooding; nine watersheds need cooperative treatment.

1970 to 1980 Program Local flood protection for the lower 13 miles of the Weiser River should be considered during this time period; some 8 miles could be deferred until after 1980. In addition, flood plain zoning and other nonstructural measures should be taken to prevent further development on the flood plain in the vicinity of Weiser. Studies are needed to determine instream flows necessary to sustain satisfactory water quality and fish and wildlife habitat. Water quality measures should include treatment of municipal and industrial pollutants and watershed management to control discharges into the streams.

New irrigation of about 900 acres and supplemental water for about 3,500 acres of water-short land could be provided by the Tamarack Reservoir. This reservoir, with about 29,000 acre-feet total capacity and 17,000 acre-feet active capacity, could be located on Weiser River about 2 miles above the town of Tamarack. This development, if found feasible, could be multipurpose and include recreational homesite development. Other than the Tamarack site, no new irrigation is likely to occur by 1980, nor are means identified to meet the supplemental water needs for the remaining 16,500 acres of water-short land. Improved water management practices would do much to offset the effects of not providing full supplies. Land treatment in the upper Weiser area also would

control erosion by providing adequate vegetative cover. Regulating logging and mining activities would reduce stream sedimentation and pollution.

Long-Range Program New storage possibilities for the 1980-2000 period include a 19,900 acre-foot enlargement of the existing Lost Valley Reservoir, 35,000 acre-feet of new offstream storage in Monday Gulch adjacent to the Little Weiser River, and a total of about 3,000 acre-feet of storage on Camp Creek. A 3,400 acre-foot facility should be considered on Sage Creek for the 2000-2020 period. Camp and Sage Creek facilities would be used primarily to supplement presently irrigated water-short lands. All of this new storage would serve recreation, flood control, and irrigation interests. They would service 13,000 acres of new irrigation and supplement 7,000 acres of water-short land. Land treatment and management practices should be accelerated in the long-range program. Cooperative treatment should be considered for three watersheds from 1980 to 2000, and for six watersheds from 2000 to 2020. Major emphasis would be on water conservation, erosion and sediment control, and streambank stabilization and channel modification. Levels of municipal and industrial waste treatments would be increased to 90 percent organic waste removal. Either ground water or convenient surface supplies would provide future municipal, industrial, and rural-domestic water needs of the basin.

Owyhee Subarea (Subregion 5)

The Owyhee Basin can be characterized as a rugged high plateau with relatively little potential for additional development because of limited water supply and short growing season. It is deeply dissected by the Owyhee River and its tributaries which flow through rugged and colorful canyons. Numerous existing small reservoirs on Owyhee River tributaries store much of the headwater runoff for downstream use. The lower river is highly regulated by Owyhee Reservoir which offers outstanding opportunities for fishing, hunting, rock collecting, and water sports in an unusually scenic, desert-like setting. With existing storage, the runoff is almost fully used to irrigate some 260,000 acres. Most flood damage occurs below Owyhee Reservoir and on Jordan Creek in the vicinity of Jordan Valley. Incidental regulation by the Owyhee Reservoir has prevented much flood damage. However, there have been instances when the reservoir was filled early for irrigation and could not control a subsequent flood.

The natural quality of the lower Owyhee River water is low. and intense irrigation use degrades it further. The water is

seasonally warm and high in sediment and dissolved solids; high nutrient concentrations have stimulated heavy algal growths.

More than 162,400 acres of irrigated land in this basin have inadequate water supplies, and opportunities for developing supplemental water are very limited. One of the most likely supplemental irrigation projects included in this plan is Jordan Creek near the Idaho-Oregon border. This 10,000-acre parcel of land has an adequate water supply during the early part of the season but needs to store early season flows for late season use. Storage of 65,000 to 100,000 acre-feet on Jordan Creek would serve the functions of flood control, wildlife, recreation, and supplemental irrigation. Fishery benefits are not possible because of excessive mercury in the drainage. About 1,270 acres of big game and upland game habitat would be inundated. Furthermore, there may be opportunity to optimize the operation of Owyhee Reservoir to better serve flood control and improved flows downstream.

A new land area of about 53,000 acres west of the existing Owyhee project and south of the town of Vale, Oregon, could be served by pumping from the Snake River and from ground water. By pumping into offstream storage from below the mouth of the Boise River, advantage would be taken of the increased flows in the Snake at that point. This basin has the greatest erosion problem of any in the Middle Snake Subregion, encompassing nearly 3,058,000 acres. Other problems include wetness on 47,500 acres and local flooding on 8,850 acres. There are 15 watersheds that need cooperative treatment.

The basin has 358 miles on several streams that were identified as having recreational value. They are: Owyhee River from Owyhee Dam downstream to the first diversion dam, from Lake Owyhee upstream 213 miles to Wild Horse Reservoir, and the North, Middle, and South Forks of the Owyhee River. Already included in Oregon's Scenic Waterways System are the segments of the South Fork Owyhee River from the Oregon-Idaho border downstream approximately 25 miles to Three Forks where the main stem Owyhee River is formed, and the segment of the main stem Owyhee River from Crooked Creek (6 miles below Rome) downstream approximately 45 miles to the mouth of Birch Creek.

The alternatives for development are extremely limited in this basin because of short water supplies and a poor land resource. Retention of the basin's environmental value is of prime consideration.

All existing water rights, including those of the Duck Valley Indian Reservation, must be considered in planning for this basin.

1970 to 1980 Program Consideration is now being given to construction of 65,000 acre-feet of storage on Jordan Creek which would reduce flood damages by 90 percent, provide recreation and resident fishing both at the reservoir and in an offstream reservoir, and firm up water supplies on 10,000 acres of irrigated land that now experience late season water shortages. Some 43,000 acres of new irrigation are also planned in Oregon. Water for 17,000 acres in the Lockett Gulch area west of Nyssa would be pumped from the Snake River and stored in a 42,000 acre-foot offstream site in the same area; local ground water would be used to irrigate the remaining 26,000 acres at various locations throughout the basin in Oregon. The minimal demand for additional municipal, industrial, and rural-domestic water supplies for this period would be met by extensions of existing systems and use of local ground water. Land management measures would be included to reduce wind erosion, primarily with vegetative cover, and to manipulate livestock grazing by establishing additional water supplies and fencing. Particularly important would be the institution of better irrigation water management practices. This would do much to alleviate the impact of now providing full water supplies to all of the irrigated land. Acquisition of 30,000 acres in the Owyhee Desert and flood plain should be considered for the preservation of upland game, waterfowl, and fur bearing animals.

Over 290 miles of the Owyhee River and its forks in Oregon and Nevada would be studied to see if they should be included in a national or state system of wild and scenic rivers. The 70 miles of the Owyhee River included in the Oregon Scenic Waterways System should also be considered for inclusion in the national wild and scenic river system. Associated lands that might also be included could total nearly 70,000 acres.

A study of Owyhee Reservoir operation would be made to determine if better operation in the interests of flood control and downstream flows can be obtained.

Long-Range Program The plan calls for irrigating an additional 10,000 acres during the period 1980 to 2000 on the plateau south of Vale. Watershed treatment and management practices, with major emphasis on erosion control, should be considered for an additional three watershed areas from 1980 to 2000 and for 12 watersheds from 2000 to 2020. A key element would be farm ponds and small reservoirs to collect local irrigation runoff for reuse and to provide opportunities for waterfowl habitat development. These small reservoirs would do much to remove suspended materials, thereby improving water quality downstream. Flow augmentation for fish and water quality control would be a key element of the program for those reaches of streams below storage in Oregon.

Malheur Subarea (Subregion 5)

The Malheur Basin is a high, rolling upland area with well developed, irrigated bottom lands. Virtually all surface flows are presently being used. Four existing reservoirs in the Malheur Basin, Agency Valley, Bully Creek, Warm Springs, and Willow Creek No. 3, provide significant regulation of streamflows. In most years they provide a full irrigation water supply to more than 130,000 acres, provide recreational opportunities, and, along with a channel and levee project at Vale, significantly reduce flood damages. The principal flood problem areas are along the Malheur River downstream from Harper and along Upper Bully Creek near Westfall. These areas are now used for agriculture but could be developed into homesites if zoning and other constraints are not imposed.

Many concentrated and continuing land treatment practices are necessary in this basin which has a large area with erosion problems (2,040,000 acres). There are also 11,100 acres with wetness problems and 9,500 acres of upstream lands subject to local flooding. Cooperative treatment is needed on 12 watersheds.

The quality of the Malheur River water is degraded by irrigation return flows, food processing wastes, and annual floods. The stream is seasonally warm, high in sediment and dissolved solids, and burdened with heavy aquatic growths. Significant discharges of untreated wastes at Ontario contribute to pollution of the stream and add substantially to the poor water quality of the Snake River.

The only undeveloped surface water supply in the basin is from infrequent high flows. Any substantial development of the half-million acres of potentially irrigable land must, therefore, be accomplished with water from other sources. As much of the basin's potentially irrigable land lies in the vicinity of the Snake River, a readily available source, the plan includes a considerable amount of irrigation development. Although some conflict exists with big game and upland game in this area, conflicts can be minimized by adequate consideration of prime wildlife habitat in formulating detailed irrigation plans. An area of 130,000 acres northwest of Ontario between the Snake River and Willow Creek could be developed with pump lifts of less than 400 feet from the Snake River. The river pumps could be located at Farewell Bend to take advantage of the Brownlee Reservoir pool.

1970 to 1980 Program Because of limited available water supplies and high costs, structural developments during this period would be limited. The only planned storage includes

80,600 acre-feet in Dry, Alkali, and Bridge Gulches, and a few ponds and small on-farm reservoirs. The plan includes three watershed areas which would receive cooperative management. Management activities would be associated with reducing wind erosion through vegetative control and better management of grazing lands by closely controlling livestock levels. Additional water supplies for livestock would be developed and fences would be constructed to control grazing. Immediate flood plain zoning and other nonstructural management would be used along the Malheur River in the vicinity of Vale and Ontario to prevent residential and commercial encroachment on the flood plains. The waste problem in the Ontario area would be dealt with during this period by installing adequate treatment facilities. Other remedial measures would be used to combat isolated instances of waste loading. Water would either be pumped into off-stream storage or used directly from Brownlee Reservoir to irrigate 80,000 acres in the vicinity of the Snake River and 20,000 acres would be developed from local ground water. No viable means to supplement the 60,000 acres of water-short lands have been identified.

Long-Range Program The plan after 1980 includes irrigation of an additional 33,000 acres by pumping from the Snake River into a 57,000 acre-feet reservoir in the Cow Hollow area. Land use conflicts are expected with big game and upland game but both needs can be achieved with a coordinated program. Water quality programs instituted prior to 1980 would be intensified by increasing waste removal efficiency. Minimum flow requirements for fish and water quality control will be better defined in the near future and, where possible, would be included in the long-range plan. Cooperative watershed management programs would be conducted on an additional four watersheds from 1980 to 2000 and on five watersheds from 2000 to 2020. Emphasis would be on erosion control.

The 1970 to 1980 programs for management of public lands will be continued during these latter time periods. However, emphasis would shift to the enhancement of lands for wildlife. Better water use is planned for some 60,000 acres which presently experience late season water shortages. Measures would include conversion to sprinkler irrigation, improvement of existing facilities, construction of farm ponds and small reservoirs to reuse runoff, installation of drains, and the conversion of low quality pasture grasses to higher yield crops. Other means to furnish supplemental water are not identified in the plan. Additionally, long-range planning should provide for using Snake River water on presently irrigated, lower elevation lands in exchange for using their water supply on higher elevation lands.

Burnt and Powder Subarea (Subregion 5)

The Burnt and Powder River drainages lie entirely within Oregon and drain mostly semiarid areas. Characteristically, the basins are composed of rolling sage covered hills and narrow valleys with an occasional expansion into broader valleys. In marked contrast are the high rugged mountains that contain the headwaters of the Powder and Burnt River tributaries. Particularly appealing is Eagle Creek drainage which heads in the Wallowa mountains. These mountains are the most esthetic of any in this study area, offering unique recreational opportunities in a setting of mountains and clear, cold streams.

The recently completed Mason Dam on the Powder River provides excellent opportunities for reservoir-oriented water sports and fishing, but some stream fishery and wildlife habitat were flooded. Irrigated lands, of which about 70 percent have substantial shortages, are located in several valleys along the Powder and Burnt Rivers. Supplemental water for these lands an development of any new irrigation would require additional storage, pumping from the Snake River, more efficient use of present supplies, and use of ground water. Because of erratic flows, irrigated lands along East Pine Creek, Wolf Creek, and the North Powder River often have too much water in the spring and then run out of water by midsummer. The serious flooding and the lack of late season irrigation water are being reduced with the construction of storage facilities on each of these streams. An estimated 30,000 acres of dry or water-short lands will be provided a full season supply, and 50,000 or more acres will be benefited during critical years when this storage is available. An estimated 15,000 acres of new land along the Powder River could be developed with ground-water pumping.

Existing reservoirs are effective in reducing flood damages to about $50,000 annually along Burnt and Powder Rivers. However, these damages are expected to more than double by 2020 if no other measures are implemented. A channel project at Baker would provide effective flood control, but it does not appear to be economically feasible before 1980. Zoning would prevent further development in the flood plain.

This basin has 831,900 acres with erosion problems, 28,700 acres with excessive wetness, and 10,000 acres of upstream land with local flooding. Nine watersheds need cooperative land treatment.

Few identifiable conflicts were encountered in selecting a plan for this basin. With limited water supplies and few good reservoir sites, it was not practical to consider large scale storage. Five small storage facilities and a limited expansion of irrigation were considered necessary if projected

food production requirements are to be met. Development of the Hardman Reservoir site and the accompanying irrigation development within the 1970-1980 period is an alternative under the regional development objective, but was included in the Long-Range Program as it was not required to meet allocated food and fiber needs for the earlier period. Some big game and upland game habitat would be destroyed, but measures would be taken to minimize losses by bypassing key habitat areas and improving habitat in other areas.

1970 to 1980 Program The plan for water quality improvement prior to 1980 includes installation of necessary facilities to adequately treat all municipal and industrial wastes; implementation of methods to reduce or prevent significant concentration of animal wastes from entering streams; and insuring the adequacy of rural-domestic and recreation waste disposal facilities. Flood plain zoning and associated management measures would be imposed along the Powder River at Baker to prevent further development on the flood plain.

Three storage reservoirs would be constructed in the Powder River drainage during this period to store 50,000 acre-feet principally for irrigation; some flood control and recreation would also be provided. The reservoirs would be on East Pine Creek, Wolf Creek, and North Fork Powder River and would provide 10,000 acres of new irrigation and supplemental water to 20,000 acres. Some ground water could be developed to irrigate an additional 15,000 acres along Powder River. Cooperative watershed management is planned on five watersheds with emphasis on water conservation measures. Other programs would involve reducing erosion, stabilizing streams, and providing drainage for much of the presently irrigated lands. Vegetative cover would be improved by range renovation and better control of livestock grazing activities on public lands. Associated with higher utilization of public lands would be construction of additional watering facilities and fences.

Long-Range Program Long-range water quality plans for Powder-Burnt Basins would be an expansion of 1970-1980 programs to include treatment of municipal and industrial wastes to remove 90 percent of the organic wastes by 2000. Construction of a flood channel on Powder River at Baker for use in conjunction with existing storage would provide almost full protection to the town of Baker. Additional power units would be installed at Brownlee and Oxbow Dams.

Construction of two storage facilities with total capacity of about 26,000 acre-feet is planned on Burnt River for the 1980-2000 period; one near Dark Canyon (12,000 acre-feet); the other

at the Hardman site (14,000 acre-feet). These reservoirs would be used mainly for irrigation but would provide some flood control and recreation. Combined, these storages along with direct diversion from the Snake River would furnish 19,000 acres of dry land with a full irrigation water supply and supplemental water to 63,000 acres of water-short land. Studies would be needed to determine the effects of these developments on wildlife and to provide remedial measures. Watershed management programs beyond 1980 would include one for the 1980-2000 period and three between 2000 and 2020 with water conservation and drainage being emphasized.

Upper Salmon Subarea (Subregion 6)

The Upper Salmon Subarea includes the headwaters of the Salmon River down to and including the North Fork and the Lemhi and Pahsimeroi Rivers, figure 14. Picturesque mountains, rugged landscape, and wild scenic rivers are the dominant features. Except for cattle ranches, this basin is largely uninhabited. Severe winters are common, but summers are very pleasant. Salmon, the largest town, is an important headquarters for a great number of back-country guides, river men, and outfitters. The Salmon River and its tributaries support a major portion of the last remaining runs of salmon and steelhead in Idaho and contain a major part of the remaining natural habitat for summer chinook, a species that has been seriously jeopardized and is in danger of extinction. The river is nationally famous for steelhead fishing.

Minor flood damages occur near Salmon, Challis, and Shoup, and along the Lemhi River. Zoning is needed at both Salmon and Challis. Channel improvement and levees would alleviate the flood problem at Challis; either upstream storage or channel improvement and levees would protect Salmon.

A total of 135,000 acres are irrigated of which some 56,000 acres have late season water shortages. To provide full supplies would require an additional 73,000 acre-feet and create depletions of about 30,000 acre-feet. Water for an additional 5,000 acres of new land would require diversion of 15,000 acre-feet and deplete water supplies by 9,400 acre-feet.

Municipal and industrial water requirements are expected to be small. All supplies should be provided at least disinfection, and most surface supplies will require complete treatment. Salmon and Challis will have trouble meeting future needs from present sources and will need to use Salmon River water with complete

treatment. Other communities should be able to expand existing supplies to meet their needs. No water development is required for navigation or hydropower. Waste loads discharged into the streams are not large now and are not expected to be great in the future. The Williams Lake Area is an exception and shows evidence of increased pollution. With this exception, the minimum flows required for water quality could be satisfied through the flows required for fish.

Although the lands in this basin do not have serious erosion or other problems, there are 440,000 acres (mostly rangeland) that have moderate erosion, 24,000 acres (mostly cropland) that have a wetness problem, and 7,000 acres of upstream land that have local flooding problems. About 137,000 acres of croplands need special land treatment. To maintain the land in a suitable condition, 14 watershed areas will require cooperative planning and treatment by 2020.

The Upper Salmon River has great recreation use now due largely to the excellent hunting and fishing and this use is expected to increase in the future. The Salmon River, and especially its upper tributaries, are vital to certain runs of anadromous fish in the Columbia River. Several million dollars have been invested in maintaining this resource. It is accessible to tourists and very desirable for summer homes. The biggest problem is to preserve this prime recreation area and still allow the resident agricultural and forestry economy to exist and prosper. The relatively modest streamflows present a great problem in making decisions between fish, wildlife, and development uses.

The studies indicate no projects for the immediate future that would have great environmental impacts. Minimum flows would be maintained and preservation of the natural environment stressed. Some adverse effects might result from the minimal program of reservoir construction, drainage, and channel improvements; but, if these are carefully done, they could have features to enhance wildlife, fishery, and recreational aspects.

Consideration should be given to water transfers out of the Upper Salmon Basin. There are several possibilities, such as transfers to the Snake, Payette, Boise, Big Wood, or Big Lost River drainages. However, in each case, environmental and biological effects on the Salmon River Basin must be evaluated.

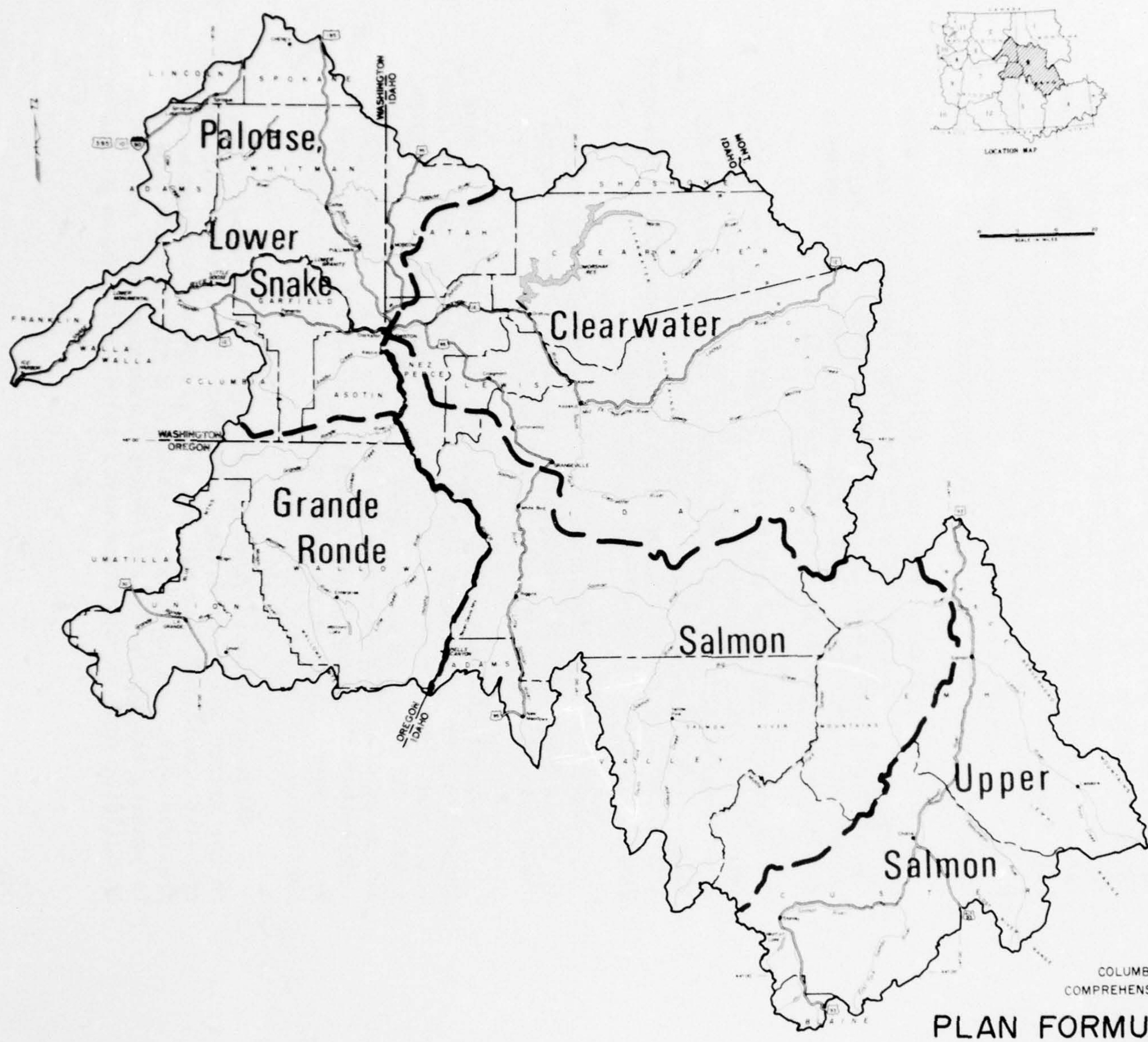
<u>1970 to 1980 Program</u> Major features of the program for this initial period include studies for the preservation of fish and wildlife, major recreation and fishing streams and scenic areas, development of additional irrigation water supplies, and institution of measures to reduce flood losses in the vicinities of Challis and Salmon.

There is a possibility for constructing 10,600 acre-feet of storage on Challis Creek to irrigate 140 acres of new land and to provide 2,600 acres of water-short land with a full supply. This facility could also provide some flood control, recreation, and minimum flows for fishery enhancement. The studies indicate development of nearly 20,000 acre-feet of ground water to irrigate 1,200 acres of new land and supplement supplies for 12,600 water-short acres, primarily through private effort.

Immediate flood plain zoning and other nonstructural measures are considered for Challis Creek in the vicinity of Challis and along Salmon River in the vicinity of Salmon. Local protective projects could also be installed for these communities using offset levees to limit the detrimental effects on fish.

Long-Range Program The long-range program deals primarily with managing the area's outstanding environmental and esthetic qualities to help meet the region's future recreational demand. Activities could include purchasing prime big game winter range and enhancing its carrying capacity through vegetative manipulation, enhancement of anadromous fish runs through construction of additional artificial production facilities, controlling soil erosion, and stabilizing streambanks. Activities beyond 1980 on recreation streams could include the management of streamside land. Watershed management programs developed in the earlier time frame would be put into action as part of the long-range program. There are nine watersheds which need cooperative treatment from 1980 to 2000 and five more from 2000 to 2020.

Four small storage projects would provide about 22,000 acre-feet of storage for a limited amount of flood control, to irrigate about 1,300 acres of new land, and to firm up supplies on 14,800 water-short acres. In addition, water could be available to supplement late season streamflow. Storage could be on Hawley, Double Springs, Bear Valley, and Agency Creeks. Their locations would not materially affect anadromous fish runs or big game winter habitat. In addition to storage, 38,000 acre-feet of ground water could be developed between 1980 and 2000 to firm up supplies for the remaining 26,000 water-short acres and to provide 2,300 acres of new irrigation. Although most of this could be developed privately, some Federal assistance may be needed. No large scale structural measures are considered, nor is additional water for irrigation needed for the 2000-2020 period.



COLUMBIA-NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

PLAN FORMULATION SUBAREAS

LOWER SNAKE SUBREGION 6

FIGURE 14

Salmon Subarea (Subregion 6)

This subarea which includes the Salmon River drainage below the North Fork, and Idaho tributaries of the Snake from Hells Canyon to the mouth of the Salmon contains some of the most rugged landscape to be found in the entire region. It contains the Idaho and Salmon River Breaks Primitive Areas which are being studied as to their suitability for inclusion in the National Wilderness Preservation system. It is virtually uninhabited and in most places nearly inaccessible. Its largest towns, New Meadows and Riggins, have only a few hundred people. This subarea has a major wildlife resource and the major Idaho fishery for salmon and steelhead. Some 90 miles of the Middle Fork Salmon River have been included in the national wild and scenic rivers system and 212 miles of the Salmon River are under study for potential inclusion in this system. Another 296 miles of rivers are considered as important recreation rivers.

The lower Salmon River and most of its tributaries flow through primitive areas with little or no development and, therefore, do not cause extensive flood damage. The major exception to this is at White Bird where channel improvements and levees along Whitebird Creek are needed.

About 5,000 acres are irrigated, all of which experience late season water shortages. An additional 6,500 acre-feet of diversions would be required to provide full water supply for these lands and would deplete supplies by 3,000 acre-feet. This water is expected to come from ground water and be developed privately. No new irrigation is necessary.

Municipal and industrial water requirements are expected to remain small and the communities should be able to expand their present sources to meet future needs.

Navigation needs are slight, but the Middle Fork is used intensively by float boats and the Salmon River is used by float boats and special power boats from below Salmon down to Riggins, a total of about 260 miles. Open river navigation on the Snake River, particularly from Johnson Bar down to the Salmon River, requires that minimum flows of about 9,500 cfs be maintained for the types of boats presently used and that fluctuations be controlled.

There are opportunities for extensive hydropower development on the Salmon and Snake Rivers. However, the free flowing rivers are also considered valuable and many groups are working hard to preserve them. An application to build a Middle Snake project is pending before the Federal Power Commission and a moratorium on building dams on the Snake River below Hells Canyon Dam is under

consideration by the Congress. The purpose of the moratorium is to give Idaho and others time to fully consider all aspects of development versus nondevelopment. This reach has also been recommended for study under section 5(d) of the Wild and Scenic Rivers Act. The Salmon River is currently under study for preservation as a wild river. The conflicts and competition of present and future uses, the questions related to providing increased food and fiber production to meet future needs, and the necessity of preserving and enhancing the environment point out the need for complete and objective studies to insure optimum use is made of the water and related land resources.

The water quality is generally good to excellent. However, with increasing recreational use (as on the Middle Fork Salmon River), logging activities, rural-domestic production, and feedlot activities, corrective measures are needed in areas bordering lakes and streams or in areas with a high water table.

This subarea is not subject to serious erosion as much of it is largely an undisturbed forest. About 2,000 acres of cropland have wetness problems, and about 48,000 acres of upstream land have local flooding problems. Nearly all of the cropland needs special land treatment. Three upstream watershed areas require cooperative planning and treatment by 2020.

The fish and wildlife attractions are well known. Big game are found throughout this subarea and measures need to be taken to maintain present herds and increase production. The Salmon River is one of the last remaining streams in the Snake Basin where anadromous fish can spawn; its preservation requires consideration.

Environmental impacts from the program would not be substantial. The preservation of great distances of free-flowing rivers and large tracts of primitive wilderness would perpetuate the opportunity of having an esthetically pleasing area for future generations.

<u>1970 to 1980 Program</u> Programs by 1980 should consist primarily of studies to determine the subarea's potential for future generations. No new irrigation, additional storage facilities, or significant amount of local protection projects would be considered. Existing emergency levees in the White Bird area should be raised and strengthened to reduce flood damages.

<u>Long-Range Program</u> Long-range activities should consist primarily of preserving and enhancing the recreational opportunities through control of developments (mining, logging, hydroelectric power, and irrigation) that could detract from the esthetic quality of the area.

Clearwater Subarea (Subregion 6)

This subarea includes the entire Clearwater River drainage. Most of it is sparsely populated, but there are the towns of Lewiston, with over 25,000 population; and Grangeville and Orofino, with nearly 4,000 population each. Like the adjacent Salmon, this area is one of great recreational and esthetic value. The rugged mountains, pristine free flowing streams, unblemished landscape, and excellent hunting and fishing make it an area of great recreational value. Part of the Selway-Bitterroot Wilderness is in the basin. Some 167 miles of the Middle Fork Clearwater, Lochsa, and Selway Rivers have been included in the national wild and scenic rivers system. Dworshak Dam will block anadromous fish from the North Fork Clearwater, but construction of the Dworshak Hatchery was designed to reestablish these fish runs to near their former abundance. The Clearwater Basin contains salmon and steelhead waters second only to the Salmon River.

Most of the existing development is located in the narrow lower valleys where it is vulnerable to flooding. The main river causes damages near Orofino, and tributaries cause flooding at Juliaetta, Stites, Kooskia, Kamiah, and Peck. Zoning is needed immediately at these towns. Control of flooding with storage would require 220,000 acre-feet of storage on the South Fork Clearwater River, as well as channel improvements and levees at the towns of Orofino, Peck, Kooskia, and Stites. Storage could cause environmental damage. The levees associated with Lower Granite Reservoir will largely eliminate Clearwater River flood damages in Lewiston.

This basin has serious erosion and other land management problems, particularly on cropland in the lower portion and from logging practices in the forests. Over 460,000 acres have erosion problems, an additional 12,000 acres have wetness problems, and 8,000 acres of upstream land have local flooding. There is a continuing need for protection and management of all the land to maintain its productivity, improve infiltration, and retard runoff. Twelve watersheds require cooperative planning and treatment by 2020.

Irrigation development has been limited by the success of dry farming and high pump lifts required to raise water to agricultural areas. Only 1,500 acres are now being irrigated in the Clearwater Basin of which 600 acres are experiencing water shortages. New irrigation would involve storage on selected tributaries of the Potlatch River and pumping from the Snake River because ground water is not reliable. Private developments are not expected to contribute materially to irrigation in the basin.

No serious water supply problems are foreseen in meeting the municipal water needs. Localized problems have occurred in the past, but it is expected that existing water sources can be utilized to meet most future requirements. Over 88 percent of the industrial water requirements are expected to occur in the Lewiston area where ample supplies are available from the Clearwater River. Elsewhere, the industrial needs should present no problems.

The Clearwater River, in general, has few sources of pollution. However, the industrial and urban concentrations in the lower part of the basin do produce wastes which need to be collected and treated. The principal industrial wastes are from forest products plants. Recreational areas also need adequate sewage disposal systems and feedlots need to be located away from surface waters. Proposed development along the shores of Dworshak Reservoir would require immediate treatment facilities. With the completion of Lower Granite Dam, slack water navigation will be provided to Lewiston. Agricultural, forest, and mining products will then have better access to the world markets.

There will be substantial power production from Dworshak Dam on the North Fork Clearwater River when it is completed. The basin also has some other excellent reservoir sites for both hydropower production and flood control. However, study will be necessary to determine how much additional development can take place and still preserve the primitive areas and the free-flowing streams. As the demand for recreation activities continues to increase, there will need to be great expansion in facilities such as campgrounds, sanitary facilities, trails, and public access to streams and key recreation areas.

All water rights, including those of the Nez Perce Indian Reservation, must be considered in the planning for this basin. There are 467,500 acres of Indian land susceptible to irrigation.

The framework program for this basin is largely oriented toward preservation of the natural environment. It includes studies of those free-flowing streams identified as having wild and scenic river potential and limits considered additional works largely to those areas currently in some state of development. Flood protection could rely largely on flood plain zoning, land treatment, and some minor levee and channel work. Incidental flood control, as well as some water based recreation, could result from construction of small irrigation reservoirs. Both in-basin storage and pumping from the Snake River could be necessary to satisfy irrigation requirements. The studies indicate the need for adequate waste treatment, municipal water supplies, fish and wildlife improvements, and land treatment.

1970 to 1980 Program The early action program relative to recreation, wildlife, and fisheries should deal with precisely identifying activities required to meet future needs. The streams to be studied include the Clearwater and its North, South, and Little North Forks; Meadow and Kelley Creeks; and the Lochsa River.

Three miles of levee and channel works at Orofino, Kooskia, and Stites, along with future potential works and incidental flood control from new upstream irrigation storage, could virtually eliminate flood damages in these areas. Flood plain zoning should be included for the communities of Juliaetta, Stites, Kooskia, and Kamiah as well as at Orofino and Peck.

Construction of an 18,000 acre-foot storage facility on Big Bear Creek in combination with large scale pumping from the Snake River is included to irrigate 10,000 acres of new land and supplement 600 acres of water-short irrigated lands. The reservoir would also provide minor flood control and some water-based recreation.

Cooperative land treatment on two watersheds from 1970 to 1980 should involve initiation of erosion control measures for some 22,000 acres. This could be accomplished primarily by nonstructural means and would greatly improve the water yield from forest lands and improve the condition of the rangeland.

Waste treatment for the Lewiston service area and at a few other towns should be upgraded to meet requirements.

Long-Range Program From 1980 to 2020, additional pumping from the Snake River could be determined by investigation of needs.

The 1980 to 2000 program includes increasing the power installation at Dworshak Dam by 660 megawatts and provisions for control of nongame fish in the reservoir and 100 miles of the Clearwater River. Activities by 2020 should include stream channel and fish habitat improvement and artificial production facilities for fish. Additional land could be acquired for stream access and for development of prime recreation areas. A considerable acreage of land and water should also be managed more carefully to retain the esthetic and recreational character of the area. Stabilization of road cuts and streambanks should be emphasized in connection with mining and logging activities. Vegetative cover should be established, both to reduce erosion and provide wildlife feed. Prime big game winter range and upland game and waterfowl habitat could be enhanced in the long-range program through controlled burning and other practices.

From 1980 to 2000 cooperative land treatment should be considered for an additional six watersheds and on four more from 2000 to 2020. As in the early time frame, activity should be involved primarily in controlling erosion by nonstructural means. Municipal, industrial, and recreational water supply and waste treatment facilities should be improved and enlarged as necessary to meet demands and quality standards.

Grand Ronde Subarea (Subregion 6)

This subarea is characterized by marked contrast in land forms. The high mountainous region, including the Eagle Cap Wilderness, is renowned for its scenic primitive beauty, big game hunting, and fishing. The rolling sage covered hills and fertile valleys support a cattle based agricultural economy. These areas are prime big game winter habitat and support significant populations of upland game and waterfowl and the streams and lakes provide excellent habitat for anadromous and resident fish. To the north and east is a range area where ancient rivers have cut deeply into the rock formations creating very rugged relief with outstanding scenic qualities. Agriculture and timber production are the primary industries, with recreation increasing in importance.

Severe flooding occurs in some places with most damages in the flat Grande Ronde Valley near LaGrande. Bank erosion occurs along the middle and lower Wallowa River. Incidental floodwater storage is provided by Wallowa Lake and other minor reservoirs and farm ponds, but some additional floodwater storage is desired locally because of other multiple-use features that could be provided. Flood plain zoning is also needed at several locations.

Existing streamflows are used to irrigate 92,000 acres, but about 55,000 acres experience late season water shortages. A portion of this shortage could be offset by better water management--especially by converting to sprinkler systems, but storage would be needed to regulate releases to meet the needs of an additional 81,000 acres of new irrigation and to supplement existing supplies. A total of 13 storage facilities with aggregate capacity of nearly one-half million acre-feet have been identified. This storage could also provide for fishery enhancement, water quality, flood control, and water based recreation.

The headwater areas of the Wallowa Mountains are subject to severe erosion due to the steep slopes and inadequate ground cover in some areas. Nearly 450,000 acres of lands (divided nearly evenly between cropland, rangeland, and forest land) have erosion problems. About 20,000 acres of cropland have wetness problems and 24,000 acres of upstream lands have local flooding problems, while around 300,000 acres of cropland need special land

treatment. Improved irrigation practices, including sprinkler application, have reduced soil erosion and drainage problems considerably. Increased irrigation would reduce the problem of wind erosion. Maintaining the lands in a productive capacity while preventing excessive erosion and lowered water quality will require coordinated multiple-purpose land and water utilization programs on 10 upstream watershed areas by 2020.

Municipal and industrial water requirements are not great, but additional development of surface supplies will be necessary to meet future needs. This will require some use of storage. Improved waste treatment facilities are also needed for cities, industries, and mining activities, in conjunction with streamflow regulation to insure suitable water quality.

Preservation of the existing scenery and natural condition along with recommended improvements are needed to satisfy the increasing demands for recreation, fish, and wildlife needs. The Eagle Cap Wilderness is now being protected, but some 294 miles along six streams require study to see if they qualify for preservation as free flowing rivers. Associated with this are an estimated 100,000 streamside acres that could be used for recreation. The Minam River is already included in the Oregon State Scenic Waterway System.

The plan developed for the Grande Ronde is not without conflict. Storage facilities would inundate considerable high quality fishery stream and prime big game winter range. However, needed development would make only minor demands on the total recreation resources.

<u>1970 to 1980 Program</u> By 1980 seven reservoirs would be constructed to supply municipal and irrigation water, improve streamflows, control flooding, and provide a reservoir fishery and water based recreation. Two authorized projects, one on the Grande Ronde River and the other on Catherine Creek, would store 220,000 acre-feet. Five small reservoirs on Lostine River, Bear Creek, Clark Creek, and Rysdam Canyon would store a total of 50,000 acre-feet. The last two sites are in the Elgin Watershed Project.

The new storage would supply water for 34,800 acres of new irrigation and firm up the supply to 18,500 acres of water-short land. About 1,000 acres of new irrigation would be developed privately in the Elgin area using ground water. Another 4,200 acres of new irrigation and 3,000 acres of supplemental irrigation would be served by ground water under Federal projects.

Flood plain zoning would be provided around LaGrande and other towns. The reservoirs on the Grande Ronde River and on Catherine Creek would reduce flood damages in the Grande Ronde Valley by 65 percent.

Four watershed projects would be accomplished during this period for erosion control, drainage, water management, and special land treatment. These measures, together with improved waste treatment at Elgin and Union and augmented streamflows, would contribute materially to improved water quality.

Studies would be made of 294 miles of the Grande Ronde, Minam, Wenaha, South Fork Wenaha, Wallowa, and Imnaha Rivers, together with 100,000 acres of streamside lands, to determine if these reaches should be included in a state or national system of wild and scenic rivers. The seven reservoirs would provide 4,500 acres of recreation water surface.

Long-Range Program During the 1980-2000 period, six Federal or federally assisted storage projects would be required, providing 200,000 acre-feet of storage. They would also furnish 2,600 acres of recreation water surface. The storage would be used to supply municipal and irrigation needs, control floods, enhance the fishery, and improve streamflows. No additional storage would be needed from 2000 to 2020.

From 1980 to 2000 an additional 38,500 acres of dry land would be irrigated and supplemental water furnished to the remaining 33,500 acres of water-short land, 90 percent of which would be from storage. This would be followed by 3,000 acres of new irrigation in the 2000-2020 period from storage.

Flood control improvements during the 1980-2000 period would consist of 11 miles of levee and channel improvements on lower Willow Creek and on the Wallowa River near Wallowa and Enterprise, plus the benefits provided by the six new storage projects.

Three watershed treatment projects would be undertaken from 1980 to 2000; two on upper areas of Grande Ronde River and one on an upper area of the Wallowa River. From 2000 to 2020 the plan includes treatment of another three watersheds; one upper area of the Grande Ronde River and two lower areas near the mouth of Grande Ronde River. Emphasis in the long-range program would be to reduce erosion primarily by vegetative means to enhance the grazing capacity for both livestock and big game and provide food and cover for upland game. By 1980, fish and wildlife enhancement programs will be better identified so that in the long-range program prime areas can be acquired and developed to

meet the recreational needs. Providing additional recreation facilities and the acquisition of associated lands will be undertaken at the storage facilities and lakes. Improved waste treatment facilities would be installed at Imbler, Island City, and Cove.

Palouse-Lower Snake Subarea (Subregion 6)

The Palouse-Lower Snake Subarea is a highly productive dryland wheat area with a tremendous erosion problem. There is considerable urban development in the subarea, including Pullman, Washington, and Moscow Idaho, with populations of 20,000 and 14,000, respectively.

When Lower Granite Dam is completed, slack water navigation will extend from the mouth of the Snake River through the subarea to Lewiston. This will result in considerable expansion in port and recreation facilities along the river. The four run-of-the-river dams, Ice Harbor, Little Goose, Lower Monumental, and Lower Granite, will have an initial installed generating capacity of 1,485 megawatts and an ultimate capacity of 3,033 megawatts.

Flooding has been a problem throughout the Asotin Creek Basin, particularly around the town of Asotin. The most extensive flood damages in the Palouse Basin have been to urban developments in Pullman and Colfax. Damages have also occurred in the Tucannon Basin, particularly in a narrow 40-mile reach in the vicinity of Starbuck. Bank erosion is a problem throughout the subarea. Flood plain zoning, flood proofing, and watershed treatment are all needed, along with local protection works and/or channel improvement at Asotin, Starbuck, Moscow, and Pullman. Storage would be effective in several areas, but it is generally too expensive or has local opposition.

At Moscow and Pullman, where ground-water tables have been dropping, there is an immediate need for additional municipal and industrial water. This could be provided from surface supplies but would require pumping some distance and probably more extensive treatment for quality. Other communities are expected to have adequate ground-water supplies.

Treatment of wastes at Moscow and Pullman needs to be upgraded and flow augmentation is required in Paradise Creek at Moscow, in South Fork Palouse River at Pullman, and in the Palouse River at Colfax. The heavy waste load from pulp and paper mills at Lewiston, municipalities, and food processing has significantly polluted the lower Snake River. An additional serious water quality problem in the lower Snake River is nitrogen gas supersaturation, apparently resulting from air entrainment at

dam spillways. This condition exists when flows exceed powerplant hydraulic capacity and where spills are made into the backwater of downstream reservoirs. The entrained nitrogen from air induces a "bends" condition in the fish which may result in their death. Work is underway to provide means for a maximum amount of water to go through the power outlets and minimize the supersaturated condition. This problem must receive primary attention in the immediate future to determine and institute the necessary remedial measures.

Only 32,000 acres are presently irrigated in this area. Expansion of irrigation by 2020 to meet projected food and fiber needs would require some 388,000 acres of new irrigation and supplemental water for 10,500 acres of water-short land. This would require an additional diversion of 1.4 million acre-feet and deplete supplies by 920,000 acre-feet. Although some ground water is available, the bulk of the additional irrigation water supply would have to come from surface sources. Available alternatives include pumping from the Snake River flows, storage on the Palouse River and its tributaries, diversions from the Spokane or Columbia Rivers, storage on the Tucannon River or its tributaries, and storage on some minor Snake River tributaries.

Erosion is a significant source of pollution in this subarea which has the highest sediment yield in the region. The Tucannon and Palouse Rivers, in particular, carry heavy sediment loads during the winter and early spring runoff season. Serious erosion problems occur on some 1.3 million acres (mostly cropland). Other land management problems include 45,000 acres with wetness problems and 91,000 acres with local flooding problems. Cooperative treatment is needed on 23 watersheds by 2020.

The plan for this subarea is not without conflicts. The major one involves an Idaho law prohibiting storage of water in Idaho for use in Washington except for municipal purposes at Pullman. Because the potential storage sites are in Idaho and most of the lands needing water are in Washington, the existing law precludes significant irrigation in the Palouse drainage unless amended. In their present condition these agriculture lands have low potential as big game or upland game habitat, whereas, with irrigation, they could provide additional upland game and waterfowl habitat. This would be especially true if key wildlife areas were acquired prior to development. Most of the irrigation development would occur after 2000 which should give appropriate agencies adequate time to incorporate enhancement of wildlife habitat into the plan.

1970 to 1980 Program During this period, and assuming the Idaho law problem can be resolved, seven small multiple-purpose reservoirs would be installed with a total capacity of 250,000 acre-feet. They would be located on Deadman and Four Mile Creeks, Palouse River and its tributaries, and at Rock Lakes. Although constructed principally for irrigation, they would also furnish some flood control and recreation. All would be Federal or federally assisted projects. Power installations at Little Goose and Ice Harbor Dams would be completed.

In addition to using stored water, the irrigation plan for 1980 includes pumping 320,000 acre-feet of water from the Snake River and pumping 16,000 acre-feet from ground water. Combined, these facilities would provide enough water to irrigate 113,000 acres of new land and provide supplemental supplies to 8,300 water-short acres. About one-third of this development, especially pumping from the Snake River to adjacent lands, is expected to be provided by private initiative and capital--the remainder from Federal and federally assisted programs.

Flood plain zoning would be instituted in the vicinity of Moscow and Pullman, on the South Fork Palouse River, near Starbuck on the Tucannon River, and near Asotin on Asotin Creek. Local protection projects are also planned during this period for these areas.

Cooperative treatment is planned on three watersheds during this period and municipal and industrial waste treatment would be upgraded.

Long-Range Program The long-range program would deal heavily in cooperative land management to reduce soil erosion, particularly in connection with construction of storage and irrigation facilities. The construction and management activities would also furnish additional water-based recreation, provide the means to establish a fishery on many of the streams and habitat for upland game and waterfowl, and control flooding.

For the 1980-2000 period, the plan calls for completion of power installations at Lower Granite and Lower Monumental Dams and for the construction of local flood protection works on Asotin Creek near Asotin; 18 additional multiple-purpose storage facilities with aggregate storage capacity of 76,000 acre-feet; additional pumping from the Snake River; and expanded ground-water pumping in the Thornton, Washington, area. In total, 238,000 acre-feet of water would be needed to irrigate 63,000 acres of new land and provide supplemental supplies to about 2,000 acres. The private sector is expected to provide about 10 percent of this development. For the 2000-2020 period, the plan includes

constructing facilities to irrigate an additional 212,000 acres. This can be accomplished with 24 small multiple-purpose storage structures totaling 150,000 acre-feet storage capacity, water diversion (565,000 acre-feet) from the Columbia River to irrigate 150,000 acres; and a small amount of additional pumping from the Snake River and ground water. During this latter stage of development, storage could be substituted for some of the water diversions from the Columbia River. Federal entities are expected to provide 90 percent of the development during this period.

In addition to irrigation, the 49 planned small storage facilities would provide recreation, flood control, and serve to reduce the level of sediment load that pollutes the streams of the area. A major problem to storage development will be the rapidity with which the reservoirs silt up. This can be greatly reduced by cultural practices to stabilize the steeply sloping soils. Most of the land treatment activity would deal with this problem. Cooperative treatment would be carried out on 17 watersheds between 1980 and 2000 and on three more during the 2000-2020 period.

Area Plans and Programs

Composition of the alternatives considered in the framework study for the Snake River area in Idaho and of the framework plan for those parts of the area in Oregon, Washington, Nevada, and Wyoming is summarized in table 60. The following sections describe elements of the plan or, for Idaho, alternatives as they relate to each function.

Electric Power

Framework studies did not indicate a need for thermal power generation in this area as projected loads are relatively light. However, geothermal development may be possible in Subregion 4. Additional power for the eastern part of the area above local hydrogeneration is expected to be supplied most economically from adjacent areas. The lower Snake Basin will continue to have hydrogeneration in excess of its needs. The phasing of power installation included in the plan is shown in table 61.

Table 61 - Phasing of Power Installations, Area B[1]

Subregion	1970 Existing	1970 Under Const.	1970 Total	1971-1980 Added	1971-1980 Total	1981-2000 Added	1981-2000 Total	2001-2020 Added	2001-2020 Total
				(installation in megawatts)					
Subregion 4									
Hydro	400	16	416	0	416	415	800	0	800
Thermal	4	0	4	0	4	0	0	0	0
Subregion 5									
Hydro	681	0	681	545	1,226	424	1,700	0	1,700
Thermal	0	0	0	0	0	0	0	0	0
Subregion									
Hydro	942	1,345	2,287	738	3,025	1,470	4,500	0	4,500
Thermal	7	0	7	0	7	0	0	0	0
Area B									
Hydro	2,023	1,363	3,384	1,283	4,667	2,309	7,000	0	7,000
Thermal	11	0	11	0	11	0	0	0	0
Total	2,034	1,363	3,395	1,283	4,678	2,300	7,000	0	7,000

1/ Nameplate ratings.
2/ After 1980, all existing small thermal plants would be retired, hydro capacity rounded to nearest 100 mw by subregion.

Hydroelectric Power The plan provides for additional hydrogeneration, mostly at existing plants or those under construction plus a few new plants. In Idaho, the study only identifies where additional hydrogeneration could occur. These elements are shown in table 62.

Table 62 - Planned Additions to Existing Projects, Area B

Project	Additional Capacity 1970-1980	1981-2000	2001-2020
		(megawatts)	
Subregion 4			
Palisades[1]	0	135	0
Lynn Crandall[2]	0	240	0
Lower Salmon-Bliss	0	40	0
Total	0	415	0
Subregion 5			
Swan Falls-Guffy	186[3]	0	0
Anderson Ranch	0	14	0
Twin Springs-Luchy Peak	0	182	0
Garden Valley-Scrivers Creek	369	0	0
Brownlee-Oxbow	0	228	0
Total	545	424	0
Subregion 6			
Dworshak	0	660	0
Lower Granite	0	405	0
Little Goose	405	0	0
Lower Monumental	0	405	0
Ice Harbor	333	0	0
Total	738	1,470	0
Area B	1,283	2,309	0

1/ Contingent on Lynn Crandall.
2/ Or equivalent storage, but with other power installation.
3/ Project would flood out an existing 10 mw plant.

Table 60 – Framework Plan Composition, Area B

Purpose or Function	Units	Subregion 4				Subregion 5				Subregion 6				Area Total			
		1970-1980	1981-2000	2001-2020	Total	1970-1980	1981-2000	2001-2020	Total	1970-1980	1981-2000	2001-2020	Total	1970-1980	1981-2000	2001-2020	Total
Water Development and Control																	
Electric Power																	
Hydro	MW	0	415	0	415	545	424	0	969	738	1,470	0	2,208	1,283	2,309	0	3,592
Thermal	MW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(Consumptive Use)	1,000 Ac. Ft.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Navigation																	
Locks	No.	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1
Channels	Miles	0	0	0	0	0	0	0	0	32	0	0	32	32	0	0	32
Breakwaters	Miles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Quality Control																	
Raw Waste Production 2/	1,000 PE	1,413	2,420	2,189	6,022	558	1,186	1,535	3,279	134	219	242	595	2,105	3,825	3,966	9,896
Waste Removal 2/	1,000 PE	1,908	2,425	1,970	6,303	811	1,158	1,381	3,350	428	239	218	885	3,147	3,822	3,569	10,538
Municipal and Industrial Water																	
Supply	MGD	49	107	133	289	40	81	95	216	19	30	29	78	108	218	257	583
Municipal	MGD	(17)	(38)	(47)	(102)	(14)	(38)	(45)	(97)	(8)	(16)	(17)	(41)	(39)	(92)	(109)	(240)
Industrial	MGD	(26)	(61)	(76)	(163)	(20)	(35)	(40)	(95)	(9)	(9)	(8)	(26)	(55)	(105)	(124)	(284)
Rural-Domestic	MGD	(6)	(8)	(10)	(24)	(6)	(8)	(10)	(24)	(2)	(5)	(4)	(11)	(14)	(21)	(24)	(59)
Diversions and Withdrawals	1,000 Ac. Ft.	55	120	149	324	45	90	107	242	20	34	33	87	120	244	289	653
Flood Control																	
Management Areas	No.	8	0	0	8	9	0	0	9	15	0	0	15	32	0	0	32
Major Stream Control (channels and levees)	Miles	52	8	0	60	34	6	13	53	12	12	0	24	98	26	13	137
Single-Purpose Storage	1,000 Ac. Ft.	0	0	0	0	5	0	1	6	0	0	0	0	5	0	1	6
Irrigation																	
New	1,000 Ac.	435	110	180	725	486	170	340	996	164	110	220	494	1,085	390	740	2,215
Supplemental	1,000 Ac.	150	175	47	372	72	70	0	142	51	76	0	127	273	321	47	641
Diversions and Withdrawals	1,000 Ac. Ft.	1,875	492	595	2,962	1,951	711	1,360	4,022	634	432	826	1,892	4,460	1,635	2,781	8,876
Multipurpose Reservoir Storage Cap.	1,000 Ac. Ft.	46	1,776	0	1,822	3,074	1,252	3	4,329	549	338	151	1,038	3,669	3,366	154	7,189
Water and Related Land Programs																	
Fish																	
Habitat Preservation (streams)	Miles	550	160	110	820	600	180	130	910	1,660	500	330	2,490	2,810	840	570	4,220
Habitat Improvement:																	
Streams	Miles	500	550	470	1,520	3,000	2,000	2,000	7,000	1,140	728	701	2,569	4,640	3,278	3,171	11,089
Lakes	1,000 Ac.	1	6	6	13	12	13	13	38	1	1	1	3	14	20	20	54
Harvest:																	
Stream Access	Miles	123	130	153	406	120	170	115	405	360	410	750	1,520	603	710	1,018	2,331
Lake Access Sites	No.	17	27	45	89	20	45	60	125	36	24	35	95	73	96	140	309
Augmentation of Supply:																	
Hatcheries	No.	1	0	0	1	1	2	2	5	1	1	0	2	3	3	2	8
Rearing Ponds	Acres	72	74	76	222	0	0	0	0	540	1,050	2,085	3,675	612	1,124	2,161	3,897
Wildlife																	
Land Acquisition	1,000 Ac.	186	192	161	539	214	162	123	499	334	48	230	612	734	402	514	1,650
Habitat Improvement	1,000 Ac.	220	235	260	715	489	1,290	876	2,655	124	148	191	463	833	1,673	1,327	3,833
Improved Hunting Access	1,000 Ac.	50	60	76	186	1,011	1,383	1,045	3,439	1,374	1,846	1,408	4,628	2,435	3,289	2,529	8,253
Augmentation of Supply																	
Game Birds	1,000 No.	6	13	15	34	1	2	3	6	38	25	51	114	45	40	69	154
Outdoor Recreation (Water Related)																	
Recreation Development	1,000 Rec. D.	2,900	8,000	14,100	25,000	3,900	9,000	14,800	27,700	1,400	3,600	6,800	11,800	8,200	20,600	35,700	64,500
Water Surface Use	Acres	3,800	15,900	28,600	48,300	6,200	17,800	31,100	55,100	1,300	6,500	12,000	19,800	11,300	40,200	71,700	123,200
Land Area (Rec. Facility Dev.)	Acres	1,700	3,500	6,500	11,700	3,700	3,800	6,400	13,900	600	900	2,600	4,100	6,000	8,200	15,500	29,700
Urban Land Acquisition	Acres	300	500	800	1,600	1,300	2,400	3,900	7,600	0	400	1,200	1,600	1,600	3,300	5,900	10,800
Boat Launch Areas	Lanes	17	94	163	274	45	75	200	320	25	50	90	165	87	219	453	759
Related Land Programs																	
Nonstructural																	
Erosion and Sediment Control	1,000 Ac.	1,923	2,106	1,674	5,703	1,771	3,034	3,189	7,994	737	1,163	1,228	3,128	4,431	6,303	6,091	16,825
Water Conservation	1,000 Ac.	432	103	175	710	479	162	327	968	164	99	213	476	1,075	364	715	2,154
Protection and Management	1,000 Ac.	6,058	4,331	4,220	NA	10,535	4,724	4,415	NA	13,535	13,474	13,416	NA	30,128	22,529	22,051	NA
Water Yield Improvement	1,000 Ac.	13	15	13	41	12	17	17	46	14	19	26	59	39	51	56	146
Structural																	
Drainage	1,000 Ac.	58	28	37	123	49	62	81	192	16	22	21	59	123	112	139	374
Trib. Stream Cont. (flood control)																	
Bank Stabilization	Miles	419	658	643	1,720	457	2,170	1,458	4,085	396	363	144	903	1,272	3,191	2,245	6,708
Dikes and Levees	Miles	21	44	45	110	264	443	529	1,236	13	17	16	46	298	504	590	1,392
Channel Improvement	Miles	673	1,085	906	2,664	700	1,475	1,717	3,892	576	772	325	1,673	1,949	3,332	2,948	8,229
Erosion Control Structures	No.	11,200	17,000	14,700	42,900	10,500	11,300	8,100	29,900	500	500	500	1,500	22,200	28,800	23,300	74,300
Ponds and Small Reservoirs	No.	2,500	3,170	3,830	9,500	9,400	9,400	10,100	28,900	1,700	3,200	4,300	9,200	13,600	15,770	18,230	47,600
Ponds and Small Reservoirs	1,000 Ac. Ft.	19	43	19	81	23	33	40	96	2	6	8	16	44	82	67	193
Coastal Zone and Estuaries																	
Estuarine Management	1,000 Ac.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beach Management	Miles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beach Stabilization	Miles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Studies																	
River Basin Studies 1/	No.	3	0	0	3	2	0	0	2	1	0	0	1	6	0	0	6
Watersheds	No.	58	41	0	99	48	47	0	95	45	17	0	62	151	105	0	256
Special Studies:																	
Preservation of Streams	Miles	928	0	0	928	953	0	0	953	1,643	0	0	1,643	3,524	0	0	3,524
Scenic Roads	Miles	374	0	0	374	334	0	0	334	460	0	0	460	1,168	0	0	1,168
Roadless Areas	1,000 Ac.	716	0	0	716	73	0	0	73	383	0	0	383	1,172	0	0	1,172
Minimum Flows	No.	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0	1
Other																	

1/ None included for Idaho on instructions from IWRB by letter dated 10-4-71.

2/ Includes municipal, industrial, and recreation uses.

New generation on the upper Snake River and the Boise River will require rather extensive studies before the plan can be determined; for purposes of showing probable costs, the upper range of power production has been included here.

Power from Pumped Storage Although there are storage sites in the area which have the potential for supporting daily/weekly cycle plants, the power losses of transmission to distant load centers makes them less than sites in the western part of the region. However, seasonal pumped storage at off stream sites could offer many advantages to the river system.

A single 66 megawatt reversible unit, along with two 20 megawatt conventional units, is included in the proposed power installation at Lucky Peak Dam. The Boise Diversion Dam, located 2.6 miles downstream, would be replaced by a higher dam having sufficient storage capacity to serve as the lower reservoir during pumped storage operation as well as a regulator for conventional hydro releases.

Summary The plan includes or identifies 3,600 megawatts of additional conventional hydro capacity. Almost 2,600 megawatts would be additions to plants either existing or under construction. Most of the remaining 1,000 megawatts will require extensive studies to determine feasibility.

Navigation

Completion of Lower Granite Dam about 1975 will bring slack water navigation to the Lewiston-Clarkston area at the confluence of the Snake and Clearwater Rivers. The remaining work during the 1970-1980 period would comprise port and terminal facilities along the upper reaches of the project and additional moorage and launching facilities for small boats. The need for further study during the 1980-2000 period was identified to determine if navigation should be extended to the confluence with the Grande Ronde River by either a navigation lock at Asotin Dam or an open river channel if Asotin Dam is not built or if this section of the river should remain undeveloped. Additional port and terminal and small boat facilities would be built as needed during this and the subsequent time period.

Minimum flows in the Snake River from Hells Canyon Dam to Lewiston should be reevaluated. Conditions satisfactory for navigation and for recreational access to the famous Hells Canyon of the Snake are not obtained with flows much less than 10,000 cfs. However, the required minimum release as specified in the FPC license

for Hells Canyon Dam is only 5,000 cfs at Johnson Bar, above the confluence with the Salmon River, and 13,000 cfs 95 percent of the time at Lime Point, below. A requirement for the larger releases is opposed by water users in Southern Idaho and Eastern Oregon as a threat to future upstream development, recreation use in Brownlee Reservoir, and existing water right. The value to navigation and recreation must be weighed against the cost in lost power and upstream development in establishing a higher minimum flow. To reduce water level fluctuations which can be up to four feet per day, either power production at Hells Canyon Dam would have to be curtailed or a small reregulating dam would have to be constructed near Johnson Bar.

Water Quality Control

Water quality control measures included are primarily for the instream control of pollution and the maintenance and enhancement of water quality. They are based on meeting state water quality standards principally through the treatment of wastes prior to discharge and through streamflow regulation. These measures would be supplemented by land treatment and other programs to reduce or eliminate the introduction of undesirable materials into waterways and aquifers.

Waste Treatment In an attempt to anticipate higher state water quality standards in the future, it was assumed that 85 percent organic waste removal would be achieved by 1980, increasing to 90 percent removal by 2000. Projected municipal, industrial, and recreation raw waste loads, waste load reduction, and treated waste discharge in terms of population equivalents (PE) are shown in table 63. Additional needs to protect water quality should be determined.

The principal stream waste loadings in the Upper and Middle Snake Subregions are from food processing; in the Lower Snake Subregion from the pulp and paper industry. These and other industrial and municipal wastes, plus a significant growth in recreational waste loadings, are expected to be the major waste discharges in the future. These wastes would be collected and adequately treated prior to discharge.

The dispersed rural-domestic wastes are generally adequately handled through individual disposal systems. Exceptions to this occur in areas where septic tank effluent is discharged to wells that may contaminate the ground water, where fields border lakes and streams, or where the water table is high. Ground water contamination, a threat in those areas overlying the Snake Plain Aquifer, is now under study to determine the needed controls. It

may be necessary to replace septic tanks in some areas with sewage collection systems or prohibit discharging these wastes to wells. Seepage from septic tanks, a source of bacterial contamination along the Payette River, Payette Lake, and the Boise River, should be collected and treated.

Livestock concentrations in the Snake River area are prime sources of pollution, particularly along the Snake, Boise, and Grande Ronde Rivers. Total raw waste production is projected to reach a human population equivalent of nearly 21 million by 1980; 28 million by 2000; and 37 million by 2020. To prevent livestock from reducing water quality it would be necessary to keep them away from watercourses and to collect and treat or make land disposal of the wastes from streamside feedlots and holding facilities.

Although not strictly a waste discharge, erosion is a major contributor to reduced water quality but particularly in the steep wheat-fallow areas of Southern Idaho and in the Palouse drainage. Improved land use and management practices are required to minimize this source of pollution. Return flow from irrigation runoff carries nutrients and some minor streams have salts that affect water quality. Planned water conservation practices would increase irrigation efficiencies and control return flows despite the increased acreage.

Nitrogen supersaturation below the lower Snake River dams presents a serious problem to the fishery resource. Steps to alleviate this problem are being taken by the Corps of Engineers.

Minimum Flows As waste treatment cannot be applied to noncollectible wastes and does not completely remove all contaminants from collectible wastes, a certain amount of streamflow is necessary for dilution and assimilation of residual wastes reaching the streams. Fish, wildlife, recreation, and esthetics also require streamflow.

Because natural flows are seasonally short throughout much of the Snake River area and are otherwise largely regulated and diverted for irrigation, the plan does not satisfy all minimum flow requirements. In Idaho, data were not available to determine instream needs; it can be concluded, however, that additional flows are needed in some streams to meet minimum flow requirements for aquatic life and water quality.

In the critical reach of the Snake River from Heise to below Milner Dam several alternatives for flow augmentation have been examined. However, further study of the ground-surface water relationship and the other potential uses of water is required

before an acceptable solution can be devised. For purposes of this study it is assumed that the alternative of a combination of storage and ground-water pumping would be used to satisfy needs.

Table 63 - Projected Raw Waste Production and Residual Discharge with Planned (or Assumed[1/]) Treatment, Area B

	1970		1980		2000		2020	
	Raw	Disch.	Raw	Disch.	Raw	Disch.	Raw	Disch.
				(1,000 p.e.)				
Subregion 4								
Municipal	202	59	265	40	420	42	611	61
Industrial	3,230	1,163	4,547	682	6,710	671	8,519	852
Recreation	90	13	123	18	225	22	414	41
Total	3,522	1,235	4,935	740	7,355	735	9,544	954
Subregion 5								
Municipal	211	27	266	40	406	41	575	58
Industrial	948	483	1,418	213	2,355	235	3,521	352
Recreation	95	15	128	19	237	24	437	44
Total	1,254	525	1,812	272	2,998	300	4,533	454
Subregion 6								
Municipal	127	28	154	23	211	21	268	27
Industrial	534	385	626	94	738	74	831	83
Recreation	44	7	59	9	109	11	201	20
Total	705	420	839	126	1,058	106	1,300	130
Area B								
Municipal	540	114	685	103	1,037	104	1,454	146
Industrial	4,712	2,031	6,591	989	9,803	980	12,871	1,287
Recreation	229	35	310	46	571	57	1,052	105
Total	5,481	2,180	7,586	1,138	11,411	1,141	15,377	1,538

1/ Applies to Idaho only.
Source: Appendix XII, Water Quality and Pollution Control.

Municipal and Industrial Water Supply

Sufficient water is generally available in most parts of the area to meet projected municipal, industrial, and rural-domestic needs, although some local problems have or will develop. In addition, the necessary level of treatment will increase as more use of surface water occurs or as ground-water quality declines. The study identified the necessary facilities to deliver and adequately treat the projected amounts of water shown in table 64.

Municipal All major service areas in Subregions 4 and 5 overlie high-yield aquifers that should easily supply future needs. Quality problems, resulting from seepage into the ground water, may become a problem and require specialized treatment. The Snake Plain Aquifer appears to be susceptible to contamination

Table 64 - Planned Municipal and Industrial Water Supply, Area B

Sub-region	Water Use	1970	1980	2000	2020
			(mgd)		
4	Municipal	53.9	70.6	109.1	156.4
	Idaho Falls Service Area	(12.0)	(16.5)	(31.3)	(46.7)
	Pocatello Service Area	(12.0)	(15.6)	(23.3)	(31.7)
	Burley Service Area	(4.5)	(6.6)	(11.1)	(17.7)
	Twin Falls Service Area	(10.1)	(13.6)	(20.4)	(32.0)
	Other	(15.3)	(18.3)	(23.0)	(28.3)
	Industrial	85.7	112.7	172.5	248.6
	Rural-Domestic	30.4	35.6	44.0	53.4
	Total	170.0	218.9	325.6	458.4
5	Municipal	48.7	63.5	100.4	145.7
	Ontario-Payette Service Area	(4.0)	(6.1)	(8.2)	(11.1)
	Boise Service Area	(31.3)	(41.6)	(70.8)	(109.2)
	Other	(13.4)	(15.8)	(21.4)	(25.4)
	Industrial	34.2	54.0	88.9	129.3
	Rural-Domestic	29.0	35.0	43.4	53.0
	Total	111.9	152.5	232.7	328.0
6	Municipal	31.7	39.0	55.4	72.0
	Lewiston Service Area	(11.0)	(14.6)	(24.2)	(34.9)
	Pullman Service Area	(6.4)	(7.9)	(10.9)	(13.5)
	Other	(14.3)	(16.5)	(20.3)	(23.6)
	Industrial	59.1	67.4	77.1	85.4
	Rural-Domestic	13.8	16.2	20.6	25.0
	Total	104.6	122.6	153.1	182.4
Area	Municipal	134.3	173.1	264.9	374.1
	Industrial	179.0	234.1	338.5	463.3
	Rural-Domestic	73.2	86.8	108.0	131.4
	Total	386.5	494.0	711.4	968.8

Source: Appendix XI, Municipal & Industrial Water Supply.

from several sources and this potential problem is under investigation. The aquifer underlying the Boise area has excessive mineral and bacterial concentrations; disinfection is already practiced but specialized treatment for taste, odor, and color may be necessary in the future.

Both quantity and quality may be problems for some communities in Subregion 5, particularly in Oregon and in the Boise area of Idaho. Each will require an individual study to identify and evaluate alternative sources of supply.

Most existing water supplies in Subregion 6 are considered adequate to meet future demands, but all will require disinfection and most surface supplies will need complete treatment. The towns of Salmon and Challis are supplied from small creeks which may not be adequate, but the Salmon River is nearby. In the Pullman Service area where ground-water levels have been steadily dropping, studies have identified several surface-water sources.

Both quantity and quality problems are present in the Grande Ronde Basin. Additional development here will involve the use of surface water and require special treatment for taste, odor, and color.

Industrial   Future industrial water needs are expected to be met from ground water where possible; otherwise, surface water will be used. The same problems discussed for municipal supplies also apply here.

Rural-Domestic   The principal problem in meeting future rural-domestic water needs is expected to be one of quality. Existing sources appear ample to meet projected growth but contamination must be continuously monitored and disinfection of each supply may be necessary. However, sound waste disposal practices and major reliance on ground water will minimize this problem.

Flood Control

Damages from flooding from both major and minor streams with the current level of protection are projected to increase from the present level of $17.7 million annually to $36.6 million by 2020. Both nonstructural and structural measures would be used to minimize these damages. Nonstructural measures, except land treatment, would be used primarily to reduce the impact of floods without actually controlling the flood waters.

Structural measures and land treatment would be used to reduce the extent and frequency of flooding.

Nonstructural Measures Flood plain information studies and regulations are required to control development so as to reduce future damages. To be fully effective, the regulations should be initiated immediately before further development occurs in flood prone areas. Regulations are needed at the following locations in the Snake River Basin:

Stream	Location
Snake River Basin	Teton County, Wyoming; Bonneville, Madison, Jefferson, Payette, Bingham, and Washington Counties, Idaho; Malheur County, Oregon
Henrys Fork Basin	Fremont and Madison Counties
Willow and Sand Creeks Basins	Bonneville County
Blackfoot River Basin	Bingham County
Portneuf River Basin	Bannock and Power Counties
Big Lost River Basin	Custer and Butte Counties
Big and Little Wood River Basins	Blaine, Lincoln, and Gooding Counties
Boise River Basin	Ada County
Malheur River Basin	Malheur County
Payette River Basin	Boise, Gem, and Payette Counties
Weiser River Basin	Washington County
Powder River Basin	Baker County
Grande Ronde River Basin	Wallowa and Union Counties
Asotin Creek	Asotin County
Clearwater River Basin	Clearwater, Lewis, Nez Perce, and Idaho Counties
Salmon River Basin	Custer and Lemhi Counties
Tucannon River Basin	Columbia County
Palouse River Basin	Latah County, Idaho; Whitman County, Washington

These studies by the Corps of Engineers, Soil Conservation Service, or Geological Survey, would provide data for planning appropriate regulations. The laws of the States of Oregon, Idaho, and Washington allow local governments to enact flood plain regulations. Similar laws are needed in Wyoming. Flood plain information reports showing the areas susceptible to flooding and providing data for planning appropriate regulation have been prepared for eight of the above locations; similar reports are needed for all the others.

Table 65 - Local Flood Protective Works, Area B

Stream	Location	Type of Work
	1970-1980	
Snake River	Jackson Hole	Channel & levee
Henrys Fork River	Lower 5 miles	Channel & levee
Henrys Fork River	Above St. Anthony	Diversion
Mud Lake	Mud Lake	Improve levee
Camas Creek	Mud Lake	Diversion
Portneuf River	Bancroft & Lava Hot Springs	Channel & levee
Little Wood River	Shoshone	Bypass channel
Big Wood River	Hailey to Bellevue	Channel & levee
Big & Little Wood Rivers	Gooding	Channel & levee
Challis Creek	Challis	Channel & levee
Boise River	Boise to mouth	Channel & levee
Cottonwood Cr.	Boise	Detention reservoir
Stuart Gulch	Boise	Detention reservoir
Weiser River	Lower 5 miles	Channel & levee
Salmon & Lemhi Rivers	Salmon	Channel & levee
Whitebird Creek	Whitebird	Improve levee
Clearwater River	Orofino & Kooskia-Stites	Channel & levee
S. Fk. Palouse River	Moscow & Pullman	Channel & levee
Tucannon River	Starbuck	Channel & levee
Blackfoot River	Blackfoot	Channel & levee
	1980-2000	
Asotin Creek	Asotin	Channel & levee
Snake River	Heise to American Falls	Levee improvement
Portneuf River	Inkom	Levee
Crane Gulch	Boise	Detention reservoir
Powder River	Baker	Flood channel
Wallowa River	Wallowa & Enterprise	Channel & levee
Willow Creek	Lower 10 miles	Channel & levee
	2000-2020	
Hulls Gulch	Boise	Detention reservoir
Weiser River	Lower 13 miles	Channel & levee

In developing the plan it was assumed that flood forecasting would be utilized to its maximum potential, particularly to assure that full use is made of joint-use storage to control flooding. It is also assumed that other nonstructural programs such as pre-flood and flood emergency activities would be continued. Although considered, no significant flood proofing is included.

Structural Measures The study identified the need for further consideration of reservoirs with a total capacity of 6,300 acre-feet. All would be located in normally dry canyons along the northern edge of the city of Boise, and flood control would be the only function served. The joint use of storage in all multiple-purpose reservoirs for flood control was also included. Diversions into the Snake River Aquifer should be made for flood control and conservation uses at three locations.

Total protection works comprising new levees or improvements to existing levees along with associated channel clearing or rectification would be constructed at 28 locations as shown in table 65. In aggregate, 130 miles of levee and channel work would be constructed.

Irrigation

Projections indicate that by 2020 some 6.4 million acres would need to be irrigated in the Snake River Area. This is an increase of 2.2 million acres above the 1970 level, nearly half of which will be needed by 1980. As the regional distribution was developed by the Irrigation Work Group, about 70 percent of the new irrigation would be in Idaho, nearly 20 percent in Washington, and 10 percent in Oregon, Nevada, and Wyoming. In addition to the new lands, over a million acres of presently irrigated lands are water-short. Means were identified to meet all of the new irrigation needs but only about 60 percent of the supplemental requirements.

Irrigation diversions for both the new and supplemental irrigation, as summarized in table 66, would increase nearly 8.9 million acre-feet annually by 2020. Of this, one-half million acre-feet would come from the Columbia River. With some 3.4 million acre-feet returning to the streams and ground water, the net depletion would amount to about 5.5 million acre-feet per year in the Snake River Area.

In a normal water year, about 2.2 million acre-feet for new development would be supplied from ground water, 4.7 million acre-feet from existing surface supplies, and the remainder from new storage. In a dry year, nearly 3 million acre-feet would come

from ground water, over 4.2 million acre-feet from existing supplies, and over 1.6 million acre-feet from new storage. This shift in use would all be in connection with use of the Snake Plain Aquifer in Subregion 4.

Private initiative and capital, both by individuals and small groups, are expected to develop approximately 25 percent of the new irrigation; the remainder would be through State, Federal, and federally assisted projects.

Much of the additional irrigation projected for the Upper Snake Subregion would depend on a combination of new storage on the Snake River or its major tributaries and pumping from the Snake Plain Aquifer. Companion to this would be replacement of irrigation storage in Jackson Lake to enhance the lake's recreational and esthetic aspects. Although many suitable storage sites have been identified and the combined surface and ground-water resources are adequate, more detailed studies are required to determine the proper combination.

Most irrigation development in the South Fork Subarea is scattered along mountain valleys and depends largely on unregulated runoff. Consequently, some 113,000 acres of presently irrigated land are short of late-season water. A minor amount of additional storage plus special water conservation measures would permit furnishing supplemental water to about 30,000 acres of water-short land and the development of 1,200 acres of new irrigation.

The 60,000 acres of new irrigation projected for Henrys Fork Basin could be supplied mostly from storage under construction on Teton River, from natural flow, and from ground water. A small amount of new storage would also be required on tributaries of Henrys Fork. Supplemental water could be supplied to 34,000 acres of presently irrigated land.

In the Heise-Neeley Subarea, nearly 227,000 acres of new irrigation could be developed and the supply to almost 54,000 water-short acres firmed up. Ground water could furnish water to 202,000 acres of new land; tributary storage could supply nearly 2,000 acres of new land and 7,000 acres of supplemental irrigation. In the Fort Hall area, some 13,000 acres of new irrigation would be developed from existing surface supplies. A combination of tributary storage, natural flow, and exchange ground-water pumping could supply nearly 10,000 acres of new land and 47,000 acres of water-short land.

New irrigation on nearly 269,000 acres and supplemental water for over 148,000 acres could be provided in the Neeley-Milner Subarea. Almost 267,000 acres of new irrigation and

Table 66 - Planned Irrigation Development, Diversions, and Depletions, Area B

Location or Basin	1970-1980				1980-2000				2000-2020				1970-2000			
	Acreage		Diver-sion	Deple-tion	Acreage		Diver-sion	Deple-tion	Acreage		Diver-sion	Deple-tion	Acreage		Diver-sion	Deple-tion
	New	Suppl.			New	Suppl.			New	Suppl.			New	Suppl.		
	(1,000 ac)		(1,000 ac-ft)		(1,000 ac)		(1,000 ac-ft)		(1,000 ac)		(1,000 ac-ft)		(1,000 ac)		(1,000 ac-ft)	
Subregion 4																
South Fork	-	-	-	-	1	30	32	12	-	-	-	-	1	30	32	12
Henrys Fork	60	3	220	106	-	31	23	7	-	-	-	-	60	34	243	113
Heise-Neeley	165	1	535	341	1	6	8	4	61	47	226	145	227	54	769	490
Neeley-Milner	86	81	440	233	108	67	387	257	74	-	238	164	268	148	1,065	654
Northern Streams	56	16	236	145	-	21	17	6	45	-	131	85	101	37	384	236
West Side	68	49	444	217	-	20	25	13		-	-	-	68	69	469	230
Total	435	150	1,875	1,042	110	175	492	299	180	47	595	394	725	372	2,962	1,735
Subregion 5																
Bruneau	58	10	245	164	-	-	-	-	340	-	1,360	918	398	10	1,605	1,082
Boise	197	-	749	492	95	-	361	238	-	-	-	-	292	-	1,110	730
Payette	77	28	324	209	-	-	-	-	-	-	-	-	77	28	324	209
Weiser	1	4	12	7	13	7	60	40	-	-	-	-	14	11	72	47
Owyhee	43	10	183	118	10	-	38	25	-	-	-	-	53	10	221	143
Malheur	100	-	380	250	33	-	125	83	-	-	-	-	133	-	505	333
Burnt Powder	10	20	58	35	19	63	127	48	-	-	-	-	29	83	185	83
Total	486	72	1,951	1,275	170	70	711	434	340	-	1,360	918	996	142	4,022	2,627
Subregion 6																
Upper Salmon	1	15	27	11	4	41	61	29	-	-	-	-	5	56	88	40
Salmon	-	5	6	3	-	-	-	-	-	-	-	-	-	5	6	3
Clearwater	10	1	41	25	5	-	20	12	5	-	20	13	20	1	81	50
Grand Ronde	40	22	118	81	38	33	113	74	3	-	7	4	81	55	238	159
Palouse-Lower Snake	113	8	442	292	63	2	238	145	212 1/	-	799	483	388 1/	10	1,479	920
Total	164	51	634	412	110	76	432	260	220 1/	-	826	500	494 1/	127	1,892	1,172
Area B	1,085	273	4,460	2,729	390	321	1,635	993	740 1/	47	2,781	1,812	2,215 1/	641	8,876	5,534
Less portion planned with Columbia River water									150	0	565	565 2/	150	0	565	565 2/
Total planned with Snake River drainage water									590	47	2,216	1,247 3/	2,065	641	8,311	4,969 3/

1/ Includes 150,000 acres developed with Columbia River water with diversions of 565,000 acre-feet and depletions of 341,000 acre-feet.
2/ Includes 341,000 acre-feet depletion of Columbia River water plus 224,000 acre-feet of return flow to Snake River drainage.
3/ Represents net depletion of Snake drainage water supply at mouth of Snake River.

120,000 acres of supplemental lands on the Oakley Fan and in the Raft River drainage could be supplied by using a combination of Snake River flows and storage, exchange ground water and local ground water. Small tributary storage and Snake River flows could supply the remainder.

In the Northern Streams Subarea, water could be supplied to nearly 37,000 acres of water-short lands and over 100,000 acres of new land. Ground water could supply 94,000 acres of the new land and over 13,000 acres of water-short land; the remainder could be supplied from small tributary storage.

Development in the West Side Subarea could irrigate nearly 68,000 acres of new land and supplement supplies for almost 70,000 acres. Some 45,000 acres of new irrigation in the Salmon Falls and Deep Creek areas could be supplied from Snake River storage, exchange ground-water pumping, and local ground water. These same sources could supplement supplies for over 49,000 acres south of the Snake River. Ground water could be used to supplement supplies to 15,000 acres in the Big Wood drainage. Some 5,000 acres would receive supplemental supplies from small tributary storage.

In the Bruneau Subarea, 398,000 acres of new irrigation could be developed and the supply firmed up on 10,000 water-short acres. Pumping from the Snake River and ground water could be used for 116,000 acres of new land; the remaining 282,000 acres could be supplied by pumping some half-million acre-feet of excess Snake River flows to offstream storage. Storage on Succor Creek could supply the supplemental lands.

Some 292,000 acres of dry land on the Mountain Home Plateau in the Boise Subarea could be irrigated by a water exchange involving the Payette, Boise, and Snake Rivers and the construction of 2.4 million acre-feet of storage on the South Fork Payette River at the Garden Valley site.

In the Payette Basin, some 67,000 acres of new irrigation could be served primarily from existing storage. An additional 10,000 acres could be developed in the upper basin using 62,000 acre-feet of storage on Gold Fork; this storage could also supplement supplies to 28,000 water-short acres.

Small tributary storage, including enlargement of Lost Valley Reservoir and construction of Tamarack Reservoir on the Weiser River, could provide irrigation on 14,000 acres of new land and supplement supplies to 11,000 acres in the Weiser Basin.

In the Owyhee Basin, some 53,000 acres west of the Owyhee Project and south of Vale would be irrigated by pumping a

combination of ground water and Snake River flows; offstream storage would be required. Storage on Jordan Creek would make supplemental water available to 10,000 acres in Jordan Valley.

In the Malheur Basin, some 113,000 acres of new land would be irrigated by pumping from the Snake River; 20,000 acres would be developed from local ground water.

Small reservoirs in the Powder and Burnt River Basins would furnish supplemental water to some 83,000 acres and permit the development of 29,000 acres of new land.

Small tributary storage in the Upper Salmon River Basin could permit development of about 1,000 acres of new land and supplement supplies to over 17,000 acres of water-short lands. Supplemental water for 39,000 acres plus the irrigation of nearly 4,000 acres of new land would be accomplished with ground-water pumping.

No additional new irrigation is anticipated in the remainder of the Salmon River drainage, but supplemental supplies are expected to be developed privately for the 5,000 acres of the water-short land, from ground water.

Irrigation of some 16,000 acres of new land plus minor supplemental irrigation is expected in the Clearwater Basin by pumping from the Snake River. Small tributary storage could be used to supply an additional 4,400 acres of new land.

Two authorized reservoirs in the Grande Ronde Subarea will store 220,000 acre-feet. These, together with several new small reservoirs, would irrigate 80,000 acres of dry land and provide supplemental water to nearly 55,000 acres of water-short land. An additional 1,000 acres is expected to be irrigated from ground water.

In the Palouse-Lower Snake Subarea, some 150,000 acres would be irrigated by diversion from the Columbia River. The remaining 238,000 acres of new land would be served from numerous small reservoirs and pumping from Snake River and ground water; these same sources would supply supplemental water to over 10,000 water-short acres.

Reservoir Storage

The framework identifies nearly 7.2 million acre-feet of storage required to help meet projected needs in the Snake River Area, table 67.

In the South Fork Subarea, three small reservoirs would provide storage for irrigation and flood control within the subarea. Major storage of approximately 1.6 million acre-feet, at one or more sites on the Snake River or its major tributaries, could provide replacement storage for Jackson Lake and essentially complete control of the upper Snake River for power generation and downstream irrigation, flood control, water quality, and fish life. The location and sizing of this storage will require further study, particularly with respect to their relation to the use of water from the Snake Plain Aquifer.

With completion of Teton Dam, only small tributary storage is required in the Henrys Fork Basin for irrigation, flood control, and recreation.

Table 67 - Planned Reservoir Storage, Area B

	Increments of Storage				
	1980	2000	2020	Total	Purpose[1/]
	(1,000 ac-ft)				
Subregion 4					
South Fork	0	1,650	0	1,650	F, FC, I, P, R, WQ
Henrys Fork	10	4	0	14	I, R
Heise-Neeley	12	74	0	86	FC, I, R
Neeley-Milner	0	19	0	19	FC, I, R
Northern Streams	24	20	0	44	I, R
West Side	0	9	0	9	FC, I, R
Total	46	1,776	0	1,822	
Subregion 5					
Bruneau	15	500	0	515	F, FC, I, R, W
Boise	335	601	1	937	FC, I, P, R, WQ
Payette	2,462	0	0	2,462	FC, I, P, R
Weiser	29	68	3	100	FC, I, R
Owyhee	107	0	0	107	FC, I, R
Malheur	81	57	0	138	I
Burnt-Powder	50	26	0	76	FC, I, R
Total	3,079	1,252	4	4,335	
Subregion 6					
Upper Salmon	11	22	0	33	F, FC, I, R, WQ
Salmon	0	0	0	0	
Clearwater	18	40	1	59	FC, I, R
Grande Ronde	270	200	0	470	F, FC, I, M, R, WQ
Palouse-Lower Snake	250	76	150	476	FC, I, R
Total	549	338	151	1,038	
Area B	3,674	3,366	155	7,195	

1/ F-Fish; FC-Flood Control; I-Irrigation; M-Municipal-Industrial; P-Power; R-Recreation; W-Wildlife; WQ-Water Quality.

If new major storage was provided above Heise, the need for new storage in the Heise-Neeley-Milner part of the area would be reduced to that which can be furnished by small tributary stream reservoirs, the largest having 70,000 acre-feet of capacity. These reservoirs could furnish water for flood control, irrigation, and recreation.

Small reservoirs in the Northern Streams and West Side Subareas could provide irrigation and flood control storage plus some recreation; the largest would store only 24,000 acre-feet.

A major offstream reservoir of about one-half million acre-feet in the Bruneau Subarea could be used to store primarily flood-flows pumped from the Snake River for irrigation purposes. This reservoir could also help meet recreation, fish, and, possibly, wildlife needs. One other 15,000 acre-foot reservoir could be used for irrigation, flood control, and recreation.

Major storage is required in the Boise River drainage for flood control purposes. Although the framework study identifies 600,000 acre-feet at the Twin Springs site principally for this purpose, there would be major conflicts with wildlife, recreation, and environmental values requiring further study before the acceptability of this storage could be determined. Such storage could also provide hydropower, lake-type recreation, and flows for water quality. A run-of-the-river power development on the Snake River in the Guffey-Swan Falls reach of some 300,000 acre-feet would also provide recreation and reduce irrigation pump lifts. Four small flood detention reservoirs should be constructed in minor canyons on the north side of Boise to protect the city.

Additional storage of 2.4 million acre-feet on the South Fork Payette River could be used for flood control, power, and for irrigation in the Boise Subarea. One other reservoir of 62,000 acre-feet in the Payette Basin could furnish flood control, recreation, and an irrigation water supply.

Storage of about 100,000 acre-feet in the Weiser Basin could be obtained by enlarging Lost Valley Dam, constructing Tamarack Valley Dam, and building additional reservoirs. These reservoirs could supply irrigation water, furnish recreational opportunities, control flooding, and enhance the fishery.

Storage of 65,000 acre-feet on Jordan Creek for flood control, recreation, and irrigation, and 42,000 acre-feet of offstream storage near Vale for irrigation are the only reservoirs included in the plan for the Owyhee Basin. The Malheur Basin would also include offstream irrigation storage; two sites with a total of 81,000 acre-feet are required.

Five small reservoirs in the Burnt and Powder Basins would store a total of 76,000 acre-feet for irrigation, flood control, and recreation.

The study identified five small reservoirs with a total of 33,000 acre-feet for the Upper Salmon Basin to satisfy irrigation, flood control, recreation, and fishery water needs. No storage is included for the remainder of the Salmon River Basin.

In the Clearwater Basin, seven small reservoirs located on tributary streams could serve irrigation, recreation, and flood control with some 59,000 acre-feet of capacity.

Some 220,000 acre-feet of the 470,000 acre-feet of storage required in the Grande Ronde Subarea would be provided by two authorized projects, one on the Grande Ronde River and one on Catherine Creek. Eleven other small reservoirs are also included for minor tributary streams. Principal functions to be served are flood control, irrigation, municipal water supply, recreation, water quality, and fish.

Numerous small reservoirs are needed in the Palouse-Lower Snake Subarea for flood control, irrigation, recreation, and sediment retention. The total storage capacity of the 49 reservoirs would be 476,000 acre-feet.

Preservation and Enhancement of Natural Environment

Preservation of Rivers The Snake River area contains 257 miles, or nearly 80 percent of the region's mileage, of rivers designated within the national wild and scenic rivers system, all in the Salmon and Clearwater Basins. An additional 286 miles of the Bruneau and Salmon Rivers have been selected by Congress for study to determine if they should be included in the system (5a status); another 604 miles in various parts of the area have been designated for study by the Secretaries of Agriculture and Interior as potential additions to the system (5d status).

During the framework study, some 2,634 miles of other streams were found to have significant recreation value. The plan provides for a study of those stream segments during 1970-1980 period to determine if they should become part of a state or national system of recreation streams. The State of Oregon has already included some of these segments in the State's Scenic Waterways System. However, the Idaho Water Resource Board has requested that those streams located in Idaho but not currently identified in, or recommended for, study under provisions of the Wild and Scenic Rivers Act be further screened to determine which ones have the highest potential for inclusion in a state or national system.

All streams included under the three designations are listed in table 68.

Minimum Flows for Environmental Values The natural environmental values of a stream depend both on the character of the shoreline and its flow characteristics. When the streamflows decrease below a reasonable level, the stream can be unattractive and lose much of its esthetic value. In addition to the environmental aspects, minimum flows of the stream are required for fisheries and for water quality. A study of all streams is required to establish a basis on which to judge the need for augmentation of flows or for control of development which either withdraws water from the stream or changes its flow pattern. Preliminary studies indicate that it may not be possible to meet minimum flow requirements and also satisfy diversion requirements.

Landscape Management and Control Landscape management and control measures adjacent to scenic roads, wild, scenic, and recreational rivers, around reservoirs, natural lakes, and as a buffer zone around recreational areas should be undertaken. The acreage required to satisfy this element has not been determined. Title in fee is not required for all lands, as the objective of this program is to provide a natural background setting to add to the enjoyment of the recreation visitors.

Wilderness and Primitive Areas There are several large areas designated under various titles for preservation in their natural state. These include a portion of Yellowstone National Park, all of Grand Teton National Park, Craters of the Moon National Monument, Seven Devils Scenic Area, Teton Wilderness, Jarbidge Wilderness, Selway-Bitterroot Wilderness, Strawberry Mt. Wilderness, Eagle Cap Wilderness, Kepuka Wilderness, Idaho Primitive Area, Birds of Prey Natural Area, and Salmon River Breaks Primitive Area. Because of the relatively undeveloped condition of much of this area, there remain other portions which may also qualify for preservation. Much of the Snake River Area and Subregion 6 in particular offer the finest opportunity in the region to enhance the National Wilderness Preservation System. Those areas specifically mentioned that should be studied for possible inclusion in this system include the Targhee, Snake River Plain, Copper Basin-Big Lost, Salmon Falls, White Cloud Peak, Kepuka, China Cup, Hells Canyon-Seven Devils, the Idaho and Salmon River Breaks Primitive Areas, west slope of Tetons, Centennial Mountains, Big Desert-Lava Beds, Bruneau-Owyhee, Lemhi Mountains, Lost River-Pahsimeroi, and Sawtooth Mountains. A thorough study is needed to determine the feasibility of these areas.

Table 68 - Potential Recreation Streams, Area B

Description	Miles	Acres at 320/mile
Subregion 4		
Rivers selected for 5(d) status under the Wild and Scenic Rivers Act, P.L. 90-542		
Snake River - segments from origin in Yellowstone National Park to head of Jackson Lake and from Jackson Lake Dam to Palisades Reservoir.	117	37,440
Henrys Fork - from Warm River to Big Springs Springs1/.	65	20,800
Gros Ventre - origin to boundary of Grand Teton National Park1/.	43	13,760
Other rivers selected for study		
Snake River - west boundary of subregion to Twin Falls.1/	30	9,600
Confluence with Raft River upstream to American Falls Reservoir.	22	7,040
Blackfoot to Palisades Dam.	137	43,840
Portneuf River - from origin to Inkom1/.	53	16,960
Blackfoot River - from origin to Blackfoot Reservoir.	20	6,400
Salt River - from origin to Palisades Reservoir.	51	16,320
Falls River - from origin to confluence with Henrys Fork.	55	17,600
Teton River - from origin to Newdale Bridge.	58	18,560
North Fork Teton River - from origin to confluence with Teton River.	28	8,960
Medicine Lodge Creek - main stem.	27	8,640
Big Wood River - above Magic Reservoir, main stem of North Fork.	51	16,320
Silver Creek - origin to confluence with Little Wood River.	6	1,920
Warm River - entire stream.	20	6,400
Hoback - origin to confluence with Snake River.	44	14,080
Greys River - origin to confluence with Snake River.	55	17,600
Big Lost River - above Mckay1/	25	8,000
North Fork - entire stream.	10	3,200
To confluence with Big Lost River.	11	3,520
Total Section 5(d)	225	72,000
Total Other Rivers	703	224,960
Subregion 4	928	296,9602/

1/ All or a portion of this stream is recommended to be considered for fish habitat preservation.
2/ Impoundments not included.

Table 68 - Continued

Description	Miles	Acres at 320/mile
Subregion 5		
Rivers designated for study in the Wild and Scenic Rivers Act, P.L. 90-542 Sec. 5(a)		
Bruneau River - entire main stem from Idaho-Nevada border to confluence with Snake River.	74	23,680
Other rivers selected for study		
Snake River - from Hammett to east boundary of subregion1/.	50	16,000
From Swan Falls to Walters Ferry.	13	4,160
Bruneau River - Nevada segment from Idaho-Nevada border.	36	11,520
Jarbidge River - origin to confluence with Bruneau River.	44	14,080
Owyhee River - from Owyhee Dam to the first diversion dam.	11	3,520
From Lake Owyhee to Wild Horse Reservoir.	213	68,160
North Fork Owyhee - main stem.	24	7,680
Middle Fork Owyhee - main stem.	17	5,440
South Fork Owyhee - main stem.	93	29,760
Boise River - free-flowing segment from the North and Middle Forks to confluence with Snake River	64	20,480
North Fork - origin to confluence with Middle Fork.	32	10,240
Middle Fork - origin to confluence with North Fork.	39	12,480
South Fork - free-flowing segment from origin to Arrowrock Reservoir.	89	28,480
Payette River - Black Canyon Reservoir to the fork joining the North and South Forks.	32	10,240
North Fork - free-flowing segment from origin to confluence with South Fork.	65	20,800
South Fork - free-flowing segment from origin to confluence with North Fork.	57	18,240
Total Federal Study Rivers Section 5(a)	74	23,680
Total Other Rivers	879	281,280
Subregion 5	953 2/	304,960 2/

1/ See footnote 1, page 320.
2/ See footnote 2, page 320.

Table 68 - Continued

Description	Miles	Acres at 320/mile
Salmon River - from town of North Fork upstream to origin.1/	175	56,000
Lemhi River - main stem.	56	17,920
Pahsimeroi River - main stem.	49	15,680
East Fork Salmon - main stem.	35	11,200
Yankee Fork - main stem.	26	8,320
Valley Creek - main stem.	21	6,720
Meadow Creek - origin to confluence with the Selway River.	35	11,200
Lochsa River - from Powell Ranger Station upstream to Selway-Bitterroot Wilderness boundary.	8	2,560
Clearwater River - main stem from Lewiston to Kooskia.1/	75	24,000
North Fork Clearwater River - main stem above Dworshak Pool.	80	25,600
Little North Fork Clearwater River - origin to confluence with North Fork Clearwater River.	112	35,840
Kelly Creek - origin to confluence with North Fork Clearwater River.	22	7,040
South Fork Clearwater River - main stem.1/	63	20,160
American River - main stem.	13	4,160
Red River - main stem.	20	6,400
Total Federal Designated Rivers	257	82,240
Total Section 5(a)	212	67,840
Total Section 5(d)	379	121,280
Total Other Rivers	1,052	336,640
Subregion 6	1,900 2/	608,000 2/
Area B, Subregions 4, 5, and 6		
Total Federal Designated Rivers	257	82,240
Total Section 5(a)	286	91,520
Total Section 5(d)	604	193,280
Total Other Rivers	2,634	842,880
	3,781 2/	1,209,920 2/

1/ See footnote 1, page 320.
2/ See footnote 2, page 320.

Table 68 - Continued

Description	Miles	Acres at 320/mile
Subregion 6		
Components of the National Wild and Scenic River System, P.L. 90-542		
Clearwater, Middle Fork - from the town of Kooskia upstream to the town of Lowell[1]	20	6,400
Lochsa River - from its junction with the Selway at Lowell forming the Middle Fork upstream to the Powell Ranger Station.	57	18,240
Selway River - from Lowell upstream to its origin.	90	28,800
Salmon, Middle Fork - from origin to confluence with the main Salmon River.[1]	90	28,800
Rivers designated for study in the Wild and Scenic Rivers Act, P.L. 90-542 Sec. 5(a)		
Salmon - segment from the town of North Fork to its[1] confluence with the Snake River	212	67,840
Rivers selected for 5(d) status under the Wild and Scenic Rivers Act, P.L. 90-542		
Snake River - main stem from Lewiston to Hells Canyon Dam.	102	32,640
Grande Ronde River, Oregon from Rondowa to confluence with Snake River.	99	31,680
Wallowa River - from Wallowa Lake to confluence with Grande Ronde.	50	16,000
Minam River - from origin to confluence with Wallowa.	46	14,720
Wenaha River - main stem and South Fork from Milk Creek to confluence with the Grande Ronde River, Oregon.	11	3,520
Imnaha River - origin of South Fork to confluence with Snake River.	71	22,720
Other rivers selected for study		
Grande Ronde River - from Wallowa to Elgin.	17	5,440
Little Salmon River - main stem.	31	9,920
Rapid River - origin to confluence with Little Salmon River.	19	6,080
South Fork - including the East Fork of the South Fork and Johnson Creek.	135	43,200
Panther Creek - main stem.	39	12,480
North Fork - main stem.	21	6,720

1/ See footnote 1, page 320.

Historic and Unique Areas This area abounds with historic, geologic, archeological, natural, and other unique sites. Presently there are numerous designated historic sites such as the Nez Perce National Historic Park (22 sites), sites along the Oregon Trail, including Fort Hall and Fort Boise, and the Lewis and Clark Trail. There are many more sites of great historic interest which need to be designated and preserved. The archeological resources of this area are tremendous but only limited excavations have been carried out. These show a considerable prehistoric settlement going back over 14,000 years. Known sites are Welman Butte Cove, Simon Cove Site, Mecham Burial Cave, Sampson Site, Wellman Creek Rockshelter, Owl Caves, Ice Harbor, and adjacent Lower Snake Sites, Marmes Rock Shelter, and Granite Point.

Geologic, natural, and unique areas that are known and deserving of recognition are: Realm of the Buttes, Big Desert and Arco Desert, Lost River and Birch Creek Sinks, St. Anthony Sand Dunes, Bruneau Jarbidge Canyon, Bruneau Sand Dunes, Thousand Springs, Swan Falls Canyon, Jordan Craters, Game Creek, Salmon Falls Canyon, China Cup Butte, Crater Rings, Big Southern Butte, Whitehorse Desert, Pine Creek, and Turnbull Pine.

There is need for an interdisciplinary study to identify the many scenic, historic, and unique areas and to prepare a plan for their preservation. The more interesting natural, archeological, and historical areas should be identified, classified, protected, and interpreted through both Federal and State systems.

Additional elements contributing to the preservation and enhancement of this natural environment are discussed under Water Quality, Fish and Wildlife, and Recreation.

Fish and Wildlife

Measures to maintain or improve the existing fish and wildlife resource base and, insofar as possible, to meet the projected fishing and hunting needs as shown in table 59 (needs summary for this area) are presented on table 60.

Fish Preservation and protection of fisheries habitat are included on an estimated 4,200 miles of streams in the area, more than half in Subregion 6. Prior to development of any streams, a study should be made of its effect on fishery habitat. Streams that should be considered are listed in table 69. These stream reaches are considered to support high quality fisheries.

Habitat improvement practices would be applied on about 11,000 miles of streams, including such measures as spawning bed

improvement, stream channel preparation, and nongame fish control. Structural improvements include bank stabilization, barriers to nongame fish, and fish ladders and screens to assure adequate fish passage. About 54,000 acres of lakes are planned for improvement measures such as nongame fish control and removal, new fishing lakes, fish pond construction and management, and development of minimum pools in reservoirs. Habitat studies to be conducted by 1980 include about 13,000 miles of stream surveys and nearly 64,000 acres of lake surveys. Adequate streamflow during the summer months, when water supplies are generally at a minimum, is vital for fish habitat protection and improvement. The Idaho Fish and Game Department has made preliminary minimum flow estimates required for fish habitat in much of this area. Completion of this information is essential for proper water resource planning; and special studies required to develop more complete minimum flow data for the entire area shown in "Nature and Extent of Further Study."

Generally, in the Snake River area, considerable additional fishing pressure and harvest can be met without serious reduction in fishing quality. The critical portion of the area is in Subregion 5 where, except for back country alpine lakes, most waters are receiving heavy fishing use and accessible trout streams require maintenance stocking of hatchery fish. Some lowland reservoirs have high warm water fish production, and some streams are lightly fished. Additional access is a prime requirement and there are over 2,330 miles of streambank where access should be acquired, as well as an additional 309 lake access sites. Some lakes and streams are presently accessible but need to be modified or enlarged to accommodate future needs. Future needs for warm water fish may be satisfied through 2020, provided the level of management continues.

Increased production in existing hatcheries could be accomplished through water reuse, controlled environment, improved food supply, disease abatement, and other techniques. Enlargement of existing hatcheries and development of eight new hatcheries (five in Subregion 5) are necessary to meet future needs as are an additional 3,897 acres of small impoundments for rearing purposes. In Subregion 5, where fishing pressures are greater and increased production needs more critical, introduction of kokanee and coho in large reservoirs and channel catfish in the Snake River above C. J. Strike Dam would provide additional supplies. Additional nongame fish control would also be helpful. Wild salmonid stocks in the Upper Snake area cannot maintain fishing quality at present levels without supplemental hatchery supplies, particularly in reservoirs and accessible stream sections.

Table 69 - Fish Habitat Considered for Preservation, Area B

Stream or Water Body	Reach
Snake River	Palisades Dam to Big Burns Canyon
Little Greys River	Entire
Granite Creek	Entire
Gros Ventre River	Entire
Buffalo Fork River	In Wyoming above Turpin Meadows
Henrys Fork and Tributaries	Above St. Anthony
Portneuf River	Above Lava Hot Springs
Snake River	Above American Falls To Ferry Butte
Spring Creek	Below Ferry Butte
Snake River	From American Falls to Lake Walcott
Rock Creek	In Twin Falls County
Snake River	From Shoshone Falls to Thousand Springs
Silver Creek	Entire
Little Wood River	Entire
East Fork Big Lost River and Tributaries	In Copper Basin
Summit Creek	Upper Tributary of Little Lost River
Big Spring Creek	Tributary of Little Lost River
Birch Creek	Above Blue Dome
Big Lost River and Tributaries	Below Mackay Reservoir
Canyon Creek	Entire
Camp Creek	Entire
Cottonwood Creek	Entire
Jake's Creek Reservoir	All
Piney Creek	Entire
Sun Creek	Entire
Shoshone Creek	Entire
Salmon Falls Creek	In Nevada
Salmon River	Entire
Clearwater River	All but North Fork

Wildlife Wildlife habitat improvement is included for an estimated 3.8 million acres between 1970 and 2020 (Subregion 4 - 715,000 acres, Subregion 5 - 2,655,000 acres, and Subregion 6 - 463,000 acres). Improvement practices would include development of shallow impoundments; potholes and guzzlers; seeding and planting of wildlife food crops (including development of 5 percent of new irrigation lands); forage release and prescribed burning; establishment of permanent openings; key area fencing of nearly 3,000 miles; and marsh developments. Habitat improvement would be accomplished in part by these specific wildlife practices and in part from multiple-use management practices that give priority consideration to wildlife habitat in critical winter range areas and important upland game and waterfowl areas. Improvement measures would also include development of bird nesting facilities, wetland development, and augmentation of bird supply by game farm rearing of some 154,000 game birds.

Land acquisition would be either by fee purchase or easement rights to assure control of wildlife habitat on about 1,650,000 acres. These areas would be managed by fish and wildlife agencies specifically for protection and enhancement of wildlife resources.

Several million acres have significant wildlife resources but their use and harvest are limited by inadequate access. To meet increased hunter demands and make full use of these resources, additional access should be provided. Many of these areas are in private ownership. Specific acreages for access corridors have not been developed. In some areas, such as the back country, major decisions regarding quantity versus quality must be made before this program is carried out. These and other wildlife habitat preservation, enhancement, and harvest requirements will be better identified following development of big game range analysis on some 22.4 million acres, upland game habitat surveys on 19.4 million acres, and completion of more than 400 habitat management plans, all scheduled for the 1970 to 1980 time period.

Land and Water Requirements Table 70 shows some of the significant water and land requirements associated with fish and wildlife elements.

Table 70 - Planned Fish & Wildlife Land and Water Requirements
Area B

Item	Units	1970	1980	2000	2020
Fish hatchery water withdrawals	1,000 ac-ft	378	450	450	486
Water withdrawals 1/ for wildlife areas	1,000 ac-ft	38	72	129	158
Fish & wildlife water areas 2/	1,000 ac	277	285	294	294
Wildlife land use 3/	1,000 ac	65,950	65,719	65,537	65,346
Controlled wildlife land use 4/	1,000 ac	217	506	571	763

1/ Includes water developments primarily for waterfowl enhancement.
2/ Includes small critical fishing waters (less than 500 acres each) and high quality waterfowl habitat.
3/ Most land area is used in varying degrees by wildlfie. Available lands will slowly be reduced by infringement of urban and industrial areas, development of special-use areas, and increased reservoir water areas, despite requirements for enhancement of wildlife resources and increasing hunting demand.
4/ Lands operated or owned and managed by fish and wildlife agencies specifically for wildlife control and enhancement.

Outdoor Recreation

Water related outdoor recreation use in this area is expected to increase from 13.9 million recreation days in 1970 to 78.4 million by 2020. Facility development and necessary land and water surface areas are included to accommodate this additional 64.5 million recreation days. Projected recreation day use and required land and water areas are given in table 60, Framework Plan Composition.

Boating activity, including sport fishing and water skiing, will increase substantially by 2020 as indicated by the projection of pleasure boats given in table 71. These activities could utilize 123,000 acres more water surface by 2020 than the 35,000 acres used in 1970. Although overall, the existing water surface available in the area far exceeds this demand, the greatest demand will occur near the urban and heavier population areas creating local surface-water deficiencies and recreationists would have to travel a greater distance to satisfy their needs. To adjust for this maldistribution of desirable recreation water surface, studies should be initiated to determine where additional new surface area is needed.

Recreation facility development would be increased from the current 5,900 acres to 35,600 acres by 2020 for water related recreation activities such as camping, picnicking, and for water access. Including lands now used to some extent for these activities, intensive facility development is planned on about 29,700 acres for picnicking and camping areas, rest facilities, boat launching areas and ramps, swimming beaches, and other related activities. About 9,000 acres would be in private development, 8,600 acres on Federal lands, 7,200 acres on county or municipal lands, and 4,900 on state lands. To meet these requirements, county and municipal authorities must acquire an estimated 6,400 acres while the State governments need to acquire some 4,400 acres.

Table 71 - Planned Elements, Recreation Boating, Area B

region	Pleasure Craft			Launching Lanes			Land Requirements		
	1970	1970-2020 (1,000)	Total	1970	1970-2020 (each)	Total	1970	1970-2020 (acres)	Total
4	12	40	52	83	274	357	180	660	840
5	12	48	60	80	320	400	170	630	800
6	6	15	21	40	165	205	90	260	350
Area B	30	103	133	203	759	962	440	1,550	1,990

Source: Appendix XIII, Recreation.

Additional water related camping and picnicking facilities and water access are particularly needed in the popular upper Snake Basin and in the vicinity of the Boise metropolitan area. Some of the principal locations are: Jackson Lake; Palisades, Teton, Lucky Peak, Anderson Ranch, Guffey, Brownlee and Owyhee Reservoirs; around many of the smaller reservoirs and lakes; along scenic streams and in mountain areas of the Snake, Henrys Fork, Boise, Payette, and Salmon River drainages.

Significant elements relating both to water related recreation and to environmental protection are the required studies of free flowing rivers, scenic roads, and roadless areas to identify those which should be formally recommended for preservation and protection. In addition to the 257 miles of waterways already officially designated as wild, scenic, or recreation rivers, table 68 in the section on "Preservation and Enhancement of the Natural Environment," lists about 3,500 miles of other streams or rivers which should be studied early in the planning period for possible inclusion in the free flowing rivers system.

Some 3,700 miles of highways and roads, having particularly scenic and esthetic attractions along streams, lakes, and rivers with surrounding mountains and forests, have been identified for the scenic road system in this area. An additional 1,170 miles of highways should be studied in the first time period to determine which should be designated and managed as scenic roads. Along with the present 3.1 million acres in primitive, wilderness, or roadless areas now established in the Snake River area, another 1.2 million acres have been identified for early study as potential additions. (Appendix XIII, Recreation).

Related Land Programs

The land programs include a broad variety of types and intensities of watershed measures and practices. These are tailored to the local specific needs to reduce erosion and sedimentation, conserve and improve water quality, and alleviate flood damages and wetness problems. This is done through a combination of management practices, land treatment measures, and, where absolutely necessary, by structural measures which by careful planning and only slightly greater cost can be made to give an assist to the entire environment. Some of the land requires many different simultaneous practices with some of them recurring in each planning period. A number of the measures would serve both watershed needs and other management objectives.

Erosion and sediment control practices should be considered on an additional 16,825,000 acres between 1970 and 2020. These practices would be mostly on rangeland in Subregions 4 and 5, but

cropland in the lower portion of Subregion 6 needs intensive erosion control practices because of the steep slopes and highly erodible soils. Also, much cropland in the Southwest portion of Subregion 4 needs intensive erosion control practices. For the entire area, these practices are needed on nearly 11.5 million acres of rangeland, over 3.5 million acres of cropland, and 1.9 million acres of forest land. On the cropland the most needed practices include those for crop residue use, conservation cropping systems, irrigation water management, stubble mulching, and land shaping, along with diversions, terraces, and grade stabilization structures. In forest areas, trees and grass would be established on eroding or deteriorating lands with particular attention following timber harvest. Existing or abandoned forest roads and trails would be stabilized. Rangeland practices include revegetation for improved cover and better control of livestock grazing. Accompanying these measures would be more than 74,000 detention structures and small check dams on cropland and rangeland.

The on-site water conservation practices on irrigated land include better water management practices for increased efficiency of present irrigation systems (along with consolidation of those systems), land leveling and shaping, conversion to sprinkler irrigation, ditch lining and pipelines to reduce transmission losses, and additional onfarm storage and control facilities. In addition to major water storage facilities, an estimated 47,600 ponds and small reservoirs would be developed with a total capacity of about 193,000 acre-feet to conserve early spring runoff for increased irrigation needs, water for stock, recreation, and wildlife use. Over one-half of those structures would be scattered throughout the rangeland.

Some 146,000 acres of forest land require special attention to improve water yield. This includes the manipulation of forest cover on 94,100 acres, 555 miles of snowpack management, and waterspreading on 15,000 acres. Forest land and rangeland require continuing protective and management practices to restore and maintain an effective vegetative cover for watershed objectives and for increased production. The grazing use by both livestock and game animals must be continually adjusted to the capacity of the land and cover. A substantial number of livestock and game water facilities would be developed for better livestock control and distribution. Timber sale contracts provide for proper watershed protection practices and for improved harvest operations to assure a minimum of even temporary damage to the watershed. Continued fire protection and suppression in both forests and on critical rangeland would be maintained. Watershed planning and management are vital elements to be included in all future land and resource development, and additional soil surveys and watershed plans would accompany future development.

A number of tributary stream control measures and adjacent land protection practices would help attain watershed objectives of erosion and sediment control, flooding, and water conservation. Detailed plans should be developed for accomplishing about 6,700 miles of bank stabilization work along streams and reservoirs between 1970 and 2020, with 3,800 miles in rangeland, 1,700 miles in forest lands, and 1,200 miles in cropland, primarily in Subregion 5. About 1,392 miles of dikes and levees should be constructed in croplands with about 89 percent in Subregion 5. Channel improvement work should be carried out along some 8,200 miles of streams and rivers with 3,900 miles in cropland, 3,200 miles in forest land, and 1,100 miles in rangeland, primarily in Subregion 5. This includes a variety of practices such as removal of obstructions and debris, measures for reduction of pollution and improved water quality, and clearing the way for fish migrations.

Excessive wetness problems, often due to the increased irrigation, require drainage practices on 374,000 acres of cropland with over one-half of these in Subregion 5 and one-third in Subregion 4.

These land treatment and management practices would help to maintain the land in a productive capacity and also to improve its infiltration and retardation capability, making better use of the 31,800,000 acre-feet of water storage capacity in the soil. They would also reduce the sediment yield from the upper watershed about 90 percent from the cropland, by 34 percent from the forest land, and by 49 percent from the rangeland. All of these practices and measures have been grouped into several major categories and are listed in table 60. Frequently, a cooperative effort by a group of land managers and owners is necessary to effectively install a combination of practices, land treatment measures, with water conservation and control structures necessary to meet the more intensive multiple-use requirements of lands and resources. Small watershed areas have been identified where the complexity of watershed problems and the multiple ownership of lands require such a coordinated effort. A substantial amount of the watershed programs and land treatment practices would also be accomplished in those areas listed in table 60. This table identifies, by time period, the number of watersheds in each subregion.

Nature and Extent of Further Studies

The Snake River Area is very complex with widely contrasting natural features, extensive developed and undeveloped resources, large needs, and many conflicts and problems to be resolved. Because of this situation, many of the alternatives identified in Idaho and aspects of the framework plan in other states must be

substantiated and tested by further study and findings to determine optimum solutions, plans, and programs ultimately to be developed or implemented. Accordingly, interdisciplinary studies are recommended for several subareas to further identify alternative methods, programs, projects, and uses of water and related land resources, to consider multiple-purpose features of each project or program, to evaluate the impacts of alternative resource uses and projects on people and the environment, and to select the proper alternatives and methods for implementation.

Studies now underway by State and Federal agencies in the Snake River Area are listed in table 72. These studies cover most of the river basins or subareas proposed for future studies. Although many of these ongoing studies have been multiple purpose in design, involving many agencies and disciplines of Federal and State government, most have placed primary emphasis on the national efficiency objective. Accordingly, the scope of these efforts should be expanded to fully consider regional development and environmental objectives, measuring to the extent possible the impacts on people and on the primary resources.

The major problems and conflicts requiring detailed studies and solutions are presented in the following sections. In addition to specific or specialized studies that may be needed or scheduled, the Bureau of Reclamation, in cooperation with all other interested land and water agencies at Federal and State levels, has undertaken a reconnaissance study of the Western States, including all of the Snake River Area, to identify means of preserving and developing resources to meet current and long-range needs, with analyses covering national economic development, regional development, and environmental goals. Companion to this study are the development of water plans by the individual states and the Northwest Comprehensive Plan being prepared by the Pacific Northwest River Basins Commission. In addition, the Department of Agriculture has underway a Type IV study for the Snake River Basin, and the Corps of Engineers is conducting a Columbia River and tributaries study which will involve portions of the Snake River Basin. These studies will give direction to many of the perplexing problems that have not been resolved in past studies.

The South Fork Subarea This subarea in Wyoming and Idaho has major environmental values which must be retained. Also, large potentials and needs for the development of storage to serve almost all functions and purposes have been identified. Particularly important are replacement of Jackson Lake storage to permit stabilization for recreation use and additional storage to satisfy instream needs. Preliminary studies have identified a number of possible storage sites, but each of these would have certain adverse effects upon the environment which precludes the definite

Table 72 - Studies Underway, Area B[1/]

Study	Purpose	Agency	Completion
Asotin Creek	Flood Plain Zoning	State of Wn.	1971
Bancroft	Flood Control	SCS	
[illegible] Creek	Multiple-Purpose	SCS	
Big Wood River	Multiple-Purpose	CE	1974
Box Elder RC&D	Multiple-Purpose	USDA & Others	
Boise River	Green Belt	Boise	
Bruneau River	Wild River	BOR	
Burnt River, Cark Canyon	Multiple-Purpose	BR	1971
Cache Creek	Multiple-Purpose	SCS	
Columbia-Blue Mt. RC&D	Multiple-Purpose	USDA & Others	
Columbia River & Tribs.	Multiple-Purpose	CE	1977
Cottonwood Creek	Multiple-Purpose	SCS	
Deadman Creek	Multiple-Purpose	SCS	
Elgin	Multiple-Purpose	SCS	
Fort Hall Reservation	Water Resource Inventory	BIA	1974
Grande Ronde River	Multiple-Purpose	BR	1972
Grande Ronde Type IV	Multiple-Purpose	Ore.-USDA	
Grande Teton National Park	Water Resource Inventory	GS	1973
Henrys Fork & Teton River Basin	Multiple-Purpose	CE	1976
Idaho Batholith	Management Plan	FS	1976
Idaho Primitive Area	Reclassification	FS	1974
Idaho-Wash. RC&D	Multiple-Purpose	USDA & Others	
Jordan Valley	Multiple-Purpose	BR	1972
Lower Snake River	Multiple-Purpose	BR	-
Lower Star Valley	Multiple-Purpose	SCS	-
Magruder Corridor	Management Plan	FS	1974-'75
Malheur Type IV	Multiple-Purpose	Ore.-USDA	
Minam & Eagle Cap Addition	Wilderness Classification	FS	1972
Minidoka	Multiple-Purpose	SCS	
Minidoka-North Side	Irrigation	BR	1974
North Powder River	Multiple-Purpose	SCS	
Owyhee Type IV	Multiple-Purpose	Ore.-USDA	
Palouse River	Multiple-Purpose	CE	1974
Palouse River	Flood Plain Zoning	State of Wn.	1971
Payette, Salmon, Boise, Challis, Sawtooth, Teton, Targhee & Bridger N. F.	Water Use Inventory	FS	1974
Pine Valley	Multiple-Purpose	SCS	-
Portneuf River	Multiple-Purpose	CE	1973
Powder Type IV	Multiple-Purpose	Ore.-USDA	-
Region-wide	Multiple-Purpose	PNWRBC	1977
Rock Creek (Power Co. & Twin Falls Co.)	Multiple-Purpose	SCS	-
Roberts-Kettle Butte	Multiple-Purpose	SCS	-
Salmon River	Wild River	FS	1973
Salmon River Breaks Primitive Area	Reclassification	FS	1974
Sand Creek	Flood Control	SCS	
Sawtooth Area	Recreation		
Snake River Basin	Multiple-Purpose	BLM	1971-'74
Snake River Type IV	Multiple-Purpose	Idaho-USDA	1972
Southwest Idaho			
Bruneau Division	Multiple-Purpose	BR	1977
Garden Valley Division	Multiple-Purpose	BR	1973
Mountain Home Division	Multiple-Purpose	BR	1974
Weiser River Division	Multiple-Purpose	BR	1971
Star Valley-Dry Creek	Multiple-Purpose	SCS	-
State Water Plan, Idaho	Multiple-Purpose	Idaho	1976
Swan Falls-Guffey	Multiple-Purpose	IWRB	-
Swift Creek	Multiple-Purpose	SCS	-
Sucker Creek	Multiple-Purpose	CE	1976
Succor Creek	Multiple-Purpose	SCS	-
Tamarack Valley	Multiple-Purpose	IWRB	1973
Tincup-Jackknife	Multiple-Purpose	SCS	-
Trail Creek	Multiple-Purpose	SCS	-
Twin Buttes	Flood Control	SCS	-
Upper Snake River			
Lower Teton	Multiple-Purpose	BR	1972
Lynn Crandall	Multiple-Purpose	BR	1972
Oakley Fan	Multiple-Purpose	BR	1976
Snake Plain Recharge	Multiple-Purpose	BR	1975
Walla Walla Project			
Milton-Freewater			
Marcus Whitman Division	Multiple-Purpose	BR	1972
Walla Walla River Basin	Water Resources	GS	1973
Western U.S. Water Plan	Multiple-Purpose	BR	1977
Western Wyoming RC&D	Multiple-Purpose	USDA & Others	-
White Cloud-Pioneer	Management Plan	FS	-
Wolf Creek	Multiple-Purpose	SCS	-
Wood River RC&D	Multiple-Purpose	USDA & Others	-

1/ This is a partial listing of studies underway and does not include all of the smaller project studies by Federal or State agencies or studies by private organizations.

selection of any of them at this time. The Bureau of Reclamation has been studying the feasibility of one of these sites (Lynn Crandall in Idaho), which was scheduled for completion in Fiscal Year 1972. However, the feasibility study is to be delayed in favor of an interim or status report outlining alternatives and enlarging the scope so as to treat more of the interrelated problems in the upper Snake area.

Precipitation management, or cloud seeding to increase precipitation, is a relatively new science that could have profound effects on the Snake River. A pilot study by the Bureau of Reclamation for this area is planned for the near future.

The Heise-Neeley Subarea This is one of the primary areas where vast acreages of irrigated land could be developed to meet the region's food and fiber goals. However, much of this potential lies within the area reserved for the National Reactor Testing Station and cannot be developed unless that designation is changed. It is also the location of the Snake Plain Aquifer which must be relied on to supply large volumes of water for diversionary and instream needs throughout the Upper and Middle Snake Subregions. However, much remains unknown about the aquifer that will require detailed studies. Questions pertain not only to supply, but also to selection of specific locations of well fields, selection of artificial recharge locations, rate of water movement in the aquifer, effects of pumping and recharge on outflow at Thousand Springs, effects on present wells in the area, water quality aspects and prevention of contamination with recharge, and other related problems. The Bureau of Reclamation, in cooperation with the U.S. Geological Survey and State of Idaho Department of Water Administration, are now conducting some preliminary studies with a report scheduled for completion in 1975.

The Heise-Neeley Subarea is also one of several areas in the upper Snake where irrigation diversion requirements appear to be excessive, resulting in adverse effects on instream needs or causing other problems. Studies are therefore required here and farther downstream with respect to determining the beneficial use requirements for irrigation; what happens to diversions not used by plants and their effect on the Snake Plain Aquifer, return flows, etc.; the feasibility of extensive canal lining, sprinkler irrigation, and other water saving programs as alternatives to developing new supplies; and the effects of water saving programs on the aquifer and flows downstream; present storage capability to regulate flows for beneficial use with the implementation of extensive water saving programs; effects of lined canals on wildlife habitat, flood control, irrigation operation and maintenance programs, farm layout, roads, or other works; and the legal and political problems that would be encountered with a water saving program and how to resolve them.

Replacement water is needed for Market and Grays Lakes. These lakes have significant potential as wildlife areas and recreational activity of various kinds if means can be provided to maintain the water at optimum levels. Enlargement of Blackfoot Reservoir is one possibility that should be studied along with ground-water development in the Blackfoot River Valley. Studies will be required to determine the amount of replacement water needed and to select the most economic source or sources that can be found. Further studies are necessary to determine the magnitude of hydroelectric power or other developments compatible with environmental purposes, or if development is to be foregone in favor of preservation.

The Neeley-Milner Subarea The subarea has serious water quality problems that could be aggravated with future development. There could be pressure to curtail development if these problems are not corrected, resulting in even more serious impacts upon people and the economy. Associated with water quality are needs for adequate flows for fish, recreation, and the general esthetic quality of the Snake River which is near one of the more populated areas of Idaho. Further study is needed regarding the potential for maintaining water quality flows by some adjustment in the operation of reservoirs and joint-use ground-water pumping for dry years. This possibility needs to be tested and proved or other means found to alleviate this problem. Studies also need to be made to determine definitely whether ground-water pumping or upstream storage, or combination thereof, is the better source for water quality flow augmentation.

Alternatives were identified in the framework study whereby minimum flows for fish could be maintained at Milner, King Hill, and other key points on the Snake River in years with average or greater runoff or when flows could be used to benefit two or more purposes simultaneously. Studies are needed to show the relationship of flows to production of fish and wildlife and to determine the feasibility of maintaining flows with single-purpose facilities as would be the situation in the Neeley-Milner subarea in many years. Furthermore, studies are also needed on almost every major river or stream to determine tolerable variations in seasonal flows for fish and wildlife.

The Lower Snake Very intensive study is required before optimum solutions to problems can be determined. In earlier sections, conflicts between hydropower development and nondevelopment or navigation have been discussed. A proposed moratorium, if passed by Congress, would defer development for an extended period of time and allow detailed studies of this important and highly controversial area. The recommendation of the Federal Power

Commission Examiner for a license but with a five-year moratorium also provides time for study. However, other bills which would immediately designate the Snake from Hells Canyon Dam to Lewiston as a national wild river would preclude additional study. Accordingly, the State of Oregon has proposed activities to re-evaluate its policy regarding development of the Snake River in those reaches where it has an interest.

Water quality aspects, such as dissolved atmospheric gases and temperature, are of prime importance to anadromous fish in the lower part of Snake River headed for the Salmon, Clearwater, and other streams. The Corps of Engineers is now studying ways to prevent the buildup of nitrogen in water spilled at the dams. The Bureau of Reclamation's Middle Snake study of power development suggested a number of ways whereby the environment could be preserved with minimum adverse effect on anadromous fish; but all issues and problems were not resolved to the satisfaction of all the major interests in this subarea. Economic and political issues are also very much a part of this problem area and must be resolved if an optimum plan is to be devised.

The Bruneau Subarea This subarea has a vast land resource requiring careful consideration if long-range needs are to be satisfied. A total of 340,000 acres of new irrigated land, identified in the framework study, is scheduled for the latter part of the long-range program because the problems involved in developing the area will require more study. The major problems are an inadequate water supply and an appropriate method of getting water to the land. An alternative identified in the framework study was for year-round pumping from the Snake River in conjunction with 500,000 acre-feet of offstream storage plus a small amount of ground-water pumping in the area. This alternative assumes that large amounts of ground water are available from the Snake Plain Aquifer to furnish flows in the Snake River and dry-year supplies. Consequently, future studies of the Snake Plain Aquifer presented in the discussion of the Heise-Neeley Subarea are also important here. If adequate supplies can be developed from the Snake Plain Aquifer or other sources, problems still remain with respect to the method of delivering water to the land. Costly pump lifts exceeding 600 feet would be required to reach the main bodies of high quality land. Lands located near the Snake River either have been developed in recent years, are low in quality, or conflict with wildlife habitat needs; and even these lands would require pump lifts of up to 500 feet. The known development alternatives to high lift pumping are a very lengthy canal system with diversion at or above Milner Dam or main stem storage located between Milner and King Hill, Idaho. All of these alternatives should be fully explored in order to select the most feasible plan.

The Owyhee Basin Here lies more water-short irrigated land than any other place in the Snake River Area and the least opportunity for developing the supplemental supplies. Of a total of 162,400 acres of water-short lands, means were identified to develop full supplies for only 10,000 acres. Most of the water-short lands (135,800 acres) are in Nevada where neither additional streamflows nor ground water are available.

General Considering all of the Snake River Area, means identified in the framework study would not provide full season water supplies for 400,000 of the 1,030,000 acres of water-short lands. Failure to fully supply all these supplemental lands represents a significant unmet need in food and fiber production for the area and the region.

Because it is physically impossible to provide the supplemental water supplies in most instances, the most likely alternative for meeting the food and fiber requirement is to develop more new land than was scheduled, either in the Snake River Area or some other area. This was done in a small way in the framework study for the Snake River Area. However, because of possible conflicts over water supplies and because it was difficult to measure or estimate the number of acres of new land required to offset the production foregone on water-short lands, enough additional new irrigation development to compensate for this shortage was not identified.

Future studies and continual monitoring of projected food and fiber requirements are needed to determine potential requirements far enough in advance so adjustments in production can be made. If the need for more production becomes critical, there is more than enough new land available to provide the requirements not supplied by the water-short lands.

Special Studies A number of special studies are required throughout the area as shown in table 73.

With current development in Idaho, conflicts involved in providing minimum flows for fish require further study. Although these conflicts have not been so noticeable in recent years of above average runoff, serious problems will appear during dry cycles. Should the decision be made to develop an additional 1.6 million acres by 2020, agricultural diversions and maintenance of minimum streamflows for fish probably will not always be compatible. Goals should be established for fishing use and emphasis placed on determining the potential under present, as well as future, conditions. Minimum flow requirements for fishery, water quality, and recreation needs should be identified soon to give water

Table 73 - Special Studies, Area B

Type	Scope
Minimum Flow Requirements	Study of selected streams to establish minimum flows for esthetices, water quality, wildlife, and fisheries. Includes cross sections of streams where required.
Stream Preservation	Study of 3,524 miles of streams to determine whether they should be included in a State or National system of recreation rivers.
Scenic, Historical, Archeological, or Unique Areas	Identify scenic, historic, archeologic, and unique areas, and develop plan for preservation and/or public use.
Boise River Green Belt Extension	Study extension of planned green belt from Lucky Peak Dam to mouth of Boise River.
Habitat Improvement for Fish and Wildlife	Identify areas where habitat can be improved effectively and develop plan for improvement.
Scenic Roads along Streams	Study relationship of roads to stream and develop a scenic road plan with proposals for improving scenic opportunities.
Primitive and Wilderness Areas	Study approximately 1.2 million acres of potential areas, particularly in Subregion 6, to determine if they should be set aside as wild or primitive areas.
Hydrologic & Water Quality Computer Model	Model Snake River, Major tributaries, and Snake Plain Aquifer to permit study of alternatives and overall effects.
Improved Irrigation Efficiency	Examine existing delivery and distribution systems for ways to increase efficiencies.
Lake Water Quality	Determine source and amount of nutrients entering lakes and reservoirs and possible controls.
Metropolitan Water Problems	Study of total water management in the Boise area.

resource planning agencies the opportunity to provide full consideration of these water using functions. The initial emphasis of the instream study should focus on sites where use or control of water is likely to change and/or where there is a need to improve streamflow conditions for aquatic life. The following sites are suggested for study: the Snake River at Heise, above the mouth of Henrys Fork, near Shelley, near Blackfoot, at Neeley, near Minidoka, below Milner Dam, at King Hill, below C. J. Strike Dam, near Murphy, at Weiser, below Hell's Canyon Dam, below its confluence with Salmon River, and at numerous Snake River tributary sites.

In order to display system effects of present and future water uses, hydrologic computer models structured to permit maximum flexibility in studying alternatives should be prepared for the Snake River and its important tributaries. Major work elements would include data on river flows, reservoir contents, diversions, return flow data, instream flow requirements, and operation of present facilities. Output of the models will include predicted flows under future development, reservoir contents, and data and information necessary to evaluate system effects.

To assist in providing new water supplies for projected demands and uses in the Snake River area, a study to improve irrigation water distribution and application is recommended. The study should evaluate present system uses and possibilities for increased efficiencies in order to save water and make it available to meet other needs. It will be necessary to identify the effects on present facilities, show incentives, identify problems associated with alternative proposals, and present costs and benefits. Particular attention should be given to those areas where diversions appear to be considerably higher than required to meet consumptive use needs, allowing for reasonable irrigation efficiencies.

System water quality models should be developed to display effects of existing and new water uses on water quality parameters at critical points. This would involve development of a general water quality simulation model to be used in conjunction with the hydrologic models to test present uses and alternative proposals. Effectiveness of waste treatment measures would also be evaluated.

Major water quality problems are developing at some lakes and reservoirs in Idaho which the establishment of water quality standards and schedules will not solve. The source and amount of nutrients in lakes and reservoirs must be determined and studies completed to determine if the amount of nutrient can be controlled or eliminated. This may require, in some cases, land use plans for shoreline areas. Alternatives should be presented and their costs and benefits determined.

As future development occurs, lands presently used in whole or in part for wildlife habitat would be infringed upon. Areas that have potential for other uses should be identified and possibilities evaluated for meeting wildlife needs. The study would propose land use plans for consideration and identify costs and benefits associated with the resulting plans. This type of study is needed throughout the Snake River area.

Flood control studies on a systems basis should be conducted on existing reservoirs to examine alternatives to existing operating procedures on reservoirs such as American Falls, Blackfoot, Magic, Mackay, Crane Creek, Cascade, and others. They should also determine whether additional regulation is needed, whether facility modifications are required; and resultant effects, upstream and downstream, should be evaluated.

Evaluation

General

Identified projects and programs for the Snake River Area provide opportunities for meeting most of the identified functional needs. Storage facilities, flood control works, irrigation and other structural elements would be located and designed to preserve as much as possible of the prime recreation, wildlife, and esthetic areas. Key environmental areas would not only be preserved, but enhanced.

The study illustrates that it will not be feasible to provide a full water supply to all of the presently irrigated water-short lands, to preserve all of the prime recreation streams and, at the same time, provide optimum streamflows for aquatic life and water quality. The food production lost by not providing full supplemental supplies can be replaced through accelerated management techniques on presently irrigated lands or by a slight increase in new irrigation either in this area or elsewhere in the region. Although needed reservoir storage would inundate 116 miles of prime recreation stream, opportunities would be provided for enhancement of 3,524 miles of key streams. For some subareas, development of single-purpose water supplies would be required if minimum fish flows are to be achieved in dry years. The feasibility of these developments will need to be determined by further study. Specific identified elements are briefly stated in the following:

(1) Environmental and esthetic values would be enhanced by:

The establishment of realistic minimum flows on all streams and augmentation of low flows in many areas to improve esthetic values, fish and wildlife habitat, and to aid in pollution control.

Waste treatment to remove 85 percent of organic wastes from municipal and industrial effluents by 1980 and 90 percent by 2000.

Study of over 3,500 miles of stream to determine their merits for inclusion with the present 257 miles in a state or national system of recreation streams and subsequent designation of those found to qualify.

(2) Fish and wildlife needs would be met by:

Preservation and protection of fish habitat on more than 4,200 miles of streams. Improvement of habitat on 11,000 miles of streams and 54,000 acres of lakes. Augmentation of the supply of fish by enlarging existing hatcheries, building 8 new hatcheries and constructing 2 miles of spawning channels. Provide access to 2,330 miles of streams and at 309 sites on lakes. This and other related activities would provide an additional 3.2 million user days of fishery recreation between 1970 and 2020.

Land acquisition or control of an additional 1.6 million acres for specific wildlife preservation and management; improvement of wildlife habitat on 3.8 million acres; and 154,000 game birds would be produced annually. Access would be improved to 8,253,000 acres. Through these and other activities, 3.5 million user days of hunting would be provided.

(3) Recreation needs would be met by:

Water-related recreation development to provide for an additional 64.5 million recreation days by 2020. This will require facility development on an additional 29,700 acres of land between 1970 and 2020 and use of 158,000 acres of water surface by 2020 as compared to the present 35,000 acres. About 11,000 acres of land would be acquired primarily for urban recreation.

Expansion of designated wilderness and primitive areas involving the study of 1.2 million acres.

Study an additional 1,200 miles of highways for possible designation as scenic roads.

(4) Municipal, industrial, and rural domestic water supplies will be provided primarily by:

Additional withdrawals from existing sources and development of some new sources to permit the withdrawal of an additional 653,000 acre-feet by 2020. It is estimated that about 10 percent would come from surface supplies.

(5) Potential storage facilities proposed include:

118 multiple-purpose installations with 6.5 million acre-feet of capacity and 4 single-purpose flood detention dams with 6,000 acre-feet capacity. Multiple-purpose storage will regulate flows for irrigation, flood control, recreation, water quality, power, navigation, and fish.

(6) In addition to that furnished by storage facilities, flood control is provided by:

Flood plain management, including flood plain regulation at 32 areas and flood information reports on 31 counties; some 129 miles of major levees and channels. Residual damages of $4.5 million would remain at 2020.

(7) Electric power would be supplied for the area and the region by:

Installation of additional capacity of nearly 2,600 MW at existing hydroelectric facilities and 1,000 MW in connection with new storage facilities.

Geothermal development in the area may also meet part of the needs.

(8) Food and fiber production needs will be met by:

Development of nearly 8.9 million acre-feet of water, nearly 7.0 million acre-feet from surface sources. Water would be provided for 641,000 acres of presently irrigated water-short land and 2,215,000 acres of new irrigation to furnish 19.3 million tons of additional production. Accelerated production techniques on dryland crops will furnish another 1.8 million tons of food and fiber by 2020.

(9) Watershed management and treatment would be accomplished on 256 watersheds by:

Erosion and sediment control on 16.8 million acres; water yield improvement on 146,000 acres of forest land; water conservation on over 2 million acres; protection and management on 46 million acres; drainage on 374,000 acres; 6,700 miles of bank stabilization; 1,392 miles of dikes and levees;

channel improvements on nearly 1,400 miles; 74,000 detention and check structures, and 47,600 small ponds and small reservoirs with a total capacity of 193,000 acre-feet.

(10) Transportation needs would be met by:

Expansion of port facilities along the existing navigation channels and additional moorage and launching facilities for small boats.

(11) Further studies would be undertaken to:

Determine the recreation potential on about 3,524 miles of recreation streams, 908 miles of scenic roads, and 0.3 million acres of primitive area by 1980. Beyond 1980, additional studies of similar areas will be made.

Determine the feasibility of providing single-purpose minimum fish flows in key reaches of the Snake River and several of its major tributaries.

Determine the best location and size for many of the identified storage facilities.

Determine the relationship and proper use of the Snake River, its major tributaries, and the Snake Plain Aquifer.

Water Resource Situation

The total water supply for the Snake Basin as a whole is ample; however, most of the water needs are in the upper and middle reaches where the water supply is not adequate. Current and projected supplies, withdrawals, and depletions are illustrated in table 74 and figure 15. Some locations where there is, or will be, an inadequate water supply to meet consumptive and instream needs are Milner Dam, Snake River at Weiser, and lower Boise River.

The present supply of 33.5 million acre-feet of surface water and 22 million acre-feet net annually recharged to the ground water would be depleted by about 5.4 million acre-feet by 2020, if the identified consumptive use needs are met. Three-fourths of these depletions would come from surface sources. Additional annual withdrawals of Snake River Basin waters would total 4.8 million by 1980, increase to 6.7 million by 2000, and to 9.2 million acre-feet by 2020. The net effect of these depletions would be to reduce the average annual flow of the Snake River at Weiser from 10.9 million acre-feet (15,000 cfs) to about 6.5 million acre-feet (9,000 cfs), and from 6.2 million acre-feet (8,600 cfs) to about 4.5 million acre-feet (6,200 cfs) at King Hill.

During the 2000 to 2020 period, an additional 565,000 acre-feet would be diverted from the Upper Columbia River Area to irrigate lands in the lower portion of the Snake drainage. Some 224,000 acre-feet of this water would be return flows to the Snake River, resulting in an additional net depletion of the region's water supply of 341,000 acre-feet.

About 90 percent of all diversions would be for irrigation use, about 3 percent each for municipal and industrial uses, 2 percent for fish and wildlife, and 1 percent for water quality and rural-domestic needs.

Instream needs include minimum flows for water quality and fish enhancement in key reaches of the Snake River and its main tributaries, and to regulate flows in the Hells Canyon to Lewiston reach of the Snake for pleasure boating. Adequate water quality flows could be achieved throughout the area except in the lower Boise and Payette Rivers and in the Snake River near Ontario, Oregon, during dry years. Desired minimum fish flows would not be obtained in many streams of the area until additional single-purpose developments are identified and constructed.

Land Resource Situation

The change in use of Snake River Area lands during the next 50 years is not expected to be significant in relation to the total land area. With nearly 69 million acres, less than one-half percent, or 266,000 acres, would be inundated by water development projects. Although the land required for urban and industrial developments and roads is expected to increase nearly 15 percent by 2020, the increase would involve less than 0.5 percent of the area's total. The major shift in land use would be a 50 percent increase of irrigated acreage, about half of which is presently dry-farmed. Total cropland would increase about 10 percent, involving little more than 1 percent of the total land area. Lands in range and forest are expected to decline about 3 and 1 percent, respectively. Lands well adapted for fish and wildlife use, which represent 95 percent of the area's total, are expected to be reduced by less than 1 percent. However, key fish and wildlife habitat may be so altered that its value to fish and wildlife may be changed. By 2020, water-related recreation areas are likely to increase substantially. A summary of planned cover and land use is given in table 75.

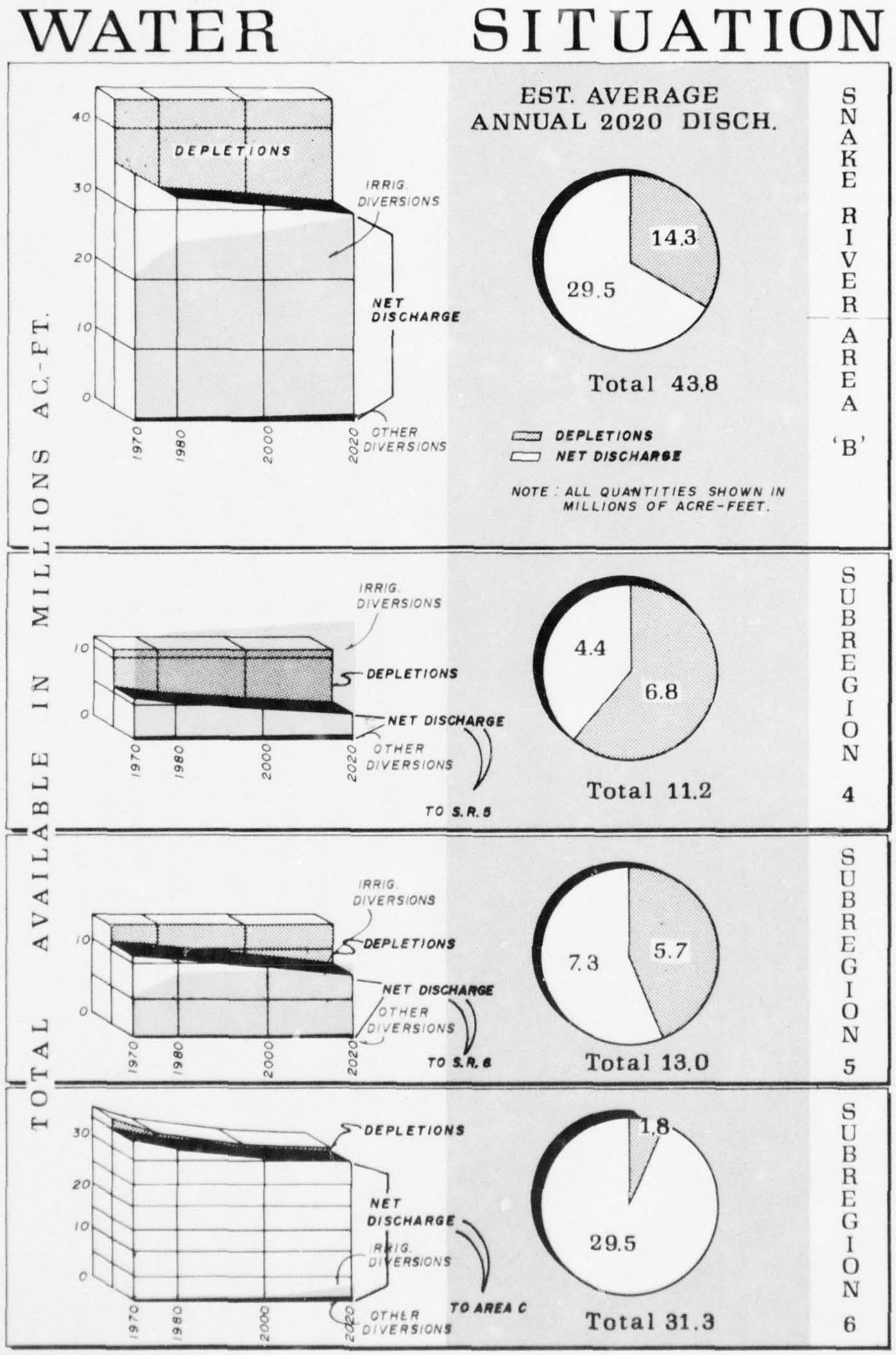


FIGURE 15. Projected Water Supplies, Withdrawals, and Depletions, Area B

Table 74 - Summary of Water Withdrawals and Depletions, Area B

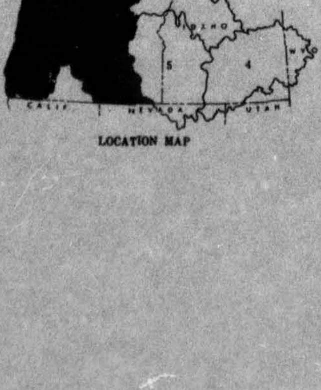
use	Ground				Surface				Total			
	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020
						(1,000 ac-ft)						
						Withdrawals						
Municipal	135	175	268	381	17	20	30	40	152	195	298	421
Industrial	133	183	286	413	68	80	94	107	201	263	380	520
Rural-Domestic	75	88	109	133	7	9	12	14	82	97	121	147
Irrigation	2,342	3,691	3,869	4,519	18,654	21,765	23,222	24,788 1/	20,996	25,456	27,091	29,307 1/
Thermal Power	-	-	-	-	-	-	-	-	-	-	-	-
Fish & Wildlife	3	11	23	28	413	511	556	616	416	522	579	644
Water Quality	0	87	44	47	0	0	0	0	0	87	44	47
Total	2,688	4,235	4,599	5,521	19,159	22,385	23,914	25,565 1/	21,847	26,620	28,513	31,086 1/
						Depletions						
Municipal	30	39	60	84	4	4	7	9	34	43	67	93
Industrial	26	37	57	82	7	8	10	12	33	45	67	94
Rural-Domestic	25	29	35	44	5	6	8	9	30	35	43	53
Irrigation	1,349	2,122	2,225	2,650	7,079	9,035	9,925	10,747 2/	8,428	11,157	12,150	13,397 2/
Thermal Power	-	-	-	-	-	-	-	-	-	-	-	-
Fish & Wildlife	2	7	13	17	53	72	91	106	55	79	104	123
Water Quality	0	0	0	0	0	0	0	0	0	0	0	0
Total	1,432	2,234	2,390	2,877	7,148	9,125	10,041	10,883 2/	8,580	11,359	12,431	13,760 2/

1/ Excludes 565,000 acre-feet diverted from Columbia River in Subregion 2 to Subregion 6.
2/ Excludes 341,000 acre-foot depletion of imported Columbia River water and additional 224,800 acre-foot to reflect net inflow to Snake River Water.

Table 75 - Summary of Planned Cover and Land Use, Area B

	Planned Amount															
	Subregion 4				Subregion 5				Subregion 6				Area B Total			
	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020
	(1,000 acres)															
Area Cover & Land Use																
Rangeland	13,556	13,362	13,355	13,350	16,839	16,332	16,200	15,897	5,042	5,040	5,038	5,036	35,437	34,734	34,593	34,283
Forest Land	4,297	4,273	4,254	4,206	4,191	4,174	4,152	4,129	13,537	13,492	13,436	13,380	22,025	21,939	21,842	21,715
Commercial	(2,515)	(2,501)	(2,483)	(2,464)	(2,819)	(2,803)	(2,781)	(2,758)	(10,257)	(10,212)	(10,156)	(10,100)	(15,591)	(15,516)	(15,420)	(15,322)
Noncommercial	(1,782)	(1,772)	(1,771)	(1,742)	(1,372)	(1,371)	(1,371)	(1,371)	(3,280)	(3,280)	(3,280)	(3,280)	(6,434)	(6,423)	(6,422)	(6,393)
Cropland	3,781	3,906	3,872	3,860	1,629	2,082	2,184	2,453	3,078	3,058	3,046	3,035	8,488	9,046	9,102	9,348
Irrigated	(2,410)	(2,842)	(2,944)	(3,119)	(1,421)	(1,900)	(2,062)	(2,389)	(268)	(432)	(531)	(743)	(4,099)	(5,174)	(5,537)	(6,251)
Nonirrigated	(1,371)	(1,064)	(928)	(741)	(208)	(182)	(122)	(64)	(2,810)	(2,626)	(2,515)	(2,292)	(4,389)	(3,872)	(3,565)	(3,097)
Other Land	1,048	1,069	1,097	1,127	739	764	795	830	714	763	823	882	2,501	2,596	2,715	2,839
Urban & Industrial	(107)	(114)	(124)	(136)	(73)	(80)	(90)	(102)	(49)	(53)	(57)	(60)	(229)	(247)	(271)	(298)
Remainder	(941)	(955)	(973)	(991)	(666)	(684)	(705)	(728)	(665)	(710)	(766)	(822)	(2,272)	(2,349)	(2,444)	(2,541)
Total Land Area	22,682	22,610	22,578	22,543	23,398	23,352	23,331	23,309	22,371	22,353	22,343	22,333	68,451	68,315	68,252	68,185
Water Surfaces 1/	266	338	370	405	170	216	237	259	81	99	109	119	517	653	716	783
Total Area	22,948	22,948	22,948	22,948	23,568	23,568	23,568	23,568	22,452	22,452	22,452	22,452	68,968	68,968	68,968	68,968
Ancillary Land Uses																
Fish & Wildlife	21,634	21,541	21,481	21,416	22,659	22,588	22,536	22,479	21,657	21,590	21,520	21,451	65,950	65,719	65,537	65,346
Water Related Recreation Facility Development	2	4	8	14	1	5	8	15	3	3	4	7	6	12	20	36
Total Irrigated Area	2,485	2,920	3,030	3,210	1,465	1,951	2,121	2,461	276	440	550	770	4,226	5,311	5,701	6,441

1/ Includes only large water bodies over 40 acres and streams over 1/8 mile in width. Smaller water areas are included in "other land" category.



LOCATION MAP

AREA C

AREA C
MID COLUMBIA RIVER, OREGON CLOSED BASINS, AND OREGON COASTAL AREA, SUBREGIONS 7, 9, 10S, and 12

Description

Area C encompasses all of Oregon except the Klamath, Goose, Lake, Snake, and Clatskanie drainages. It also includes that portion of Washington drained by the Klickitat, White Salmon, and Walla Walla Rivers which are tributaries of the Columbia River. The area contains a total of 76,850 square miles.

Major Columbia River tributaries in Oregon are the Umatilla, John Day, Deschutes, Hood, Sandy, and Willamette Rivers. The Oregon Closed Basin Subregion portion of Area C has no hydrologic outlet. The Silvies, Silver, Donner und Blitzen, and Chewaucan Rivers are the largest streams and they, together with other minor streams, flow into Summer, Silver, Abert, Harney, and Malheur Lakes. Also included in Area C are all the streams flowing into the Pacific Ocean from the Columbia River south to the California State line. The major streams are the Umpqua and Rogue Rivers and the minor ones include the Nehalem, Wilson, Nestucca, Siletz, Yaquina, Alsea, Siuslaw, Coos, Coquille, and Chetco Rivers.

Perhaps the most unusual attribute of the area is its wide variations in geography and climate, which account for many differences in land, land cover, and scenic and esthetic values. The terrain ranges from the beautiful undeveloped beaches and rocky coastline to several high mountain ranges with many valleys to "high desert" plateaus. The major ranges include the Klamath, Coast, Cascade, and Blue Mountains. Forest cover varies from predominantly spruce-hemlock near the coast, to Douglas-fir, and thence to ponderosa pine progressing inland; however, the southeastern portion of Area C is relatively bare of forest. Forests cover 53 percent of the land area, nearly one-third is rangeland, and about 12 percent is cropland.

Plant cover and the agricultural crops that can be grown are dependent primarily upon three somewhat related factors--distance from the ocean, precipitation, and elevation. These factors result in a variation from a humid, two-season, marine climate west of the Cascade Range to a cold and hot, four-season, dry climate in the central and eastern parts. One climatic feature, common to the entire area, is that most of the precipitation comes in late fall, winter, and early spring, leaving July, August, and September with negligible rainfall. Therefore, irrigation becomes an important factor to agricultural production regardless of the annual precipitation. Statistically, the average annual precipitation varies from less than 8 to over 200 inches, and the agricultural growing season from less than 80 to 300 days per year, making a wide range of crops possible.

Historically, the area has been noted for products associated with its natural resources. The majority of its workers have been directly involved in producing, harvesting, or processing forest and agricultural products or providing goods and services for those who were. The economy is still resource oriented, but there is a growing trend toward service and "footloose" manufacturing industries.

The area has other resource-based industries. Large quantities of gold, silver, copper, lead, zinc, mercury, and chromium have been mined in the past. There are still extensive deposits of metallic minerals available, but at the present, activity is practically nil due to low prices. Nonmetallic minerals such as the construction materials, stone, sand, gravel, cinder, and pumice are readily available and practically inexhaustible in some places. No significant mineral fuel deposits have been found, but several small coal deposits have been located.

The population in 1970 was 2,021,000. About 70 percent resided in the Willamette Subregion where the three largest cities, Portland, Eugene, and Salem, are located. The largest, Portland, has a population of 383,000. Other parts of Area C are relatively sparsely populated with the Closed Basin containing the least. Important cities outside the Willamette Basin include Medford and Grants Pass in the Rogue Basin, Roseburg in the Umpqua Basin, Astoria and Coos Bay on the coast, Bend, Pendleton, Walla Walla, Kennewick, and The Dalles in Subregion 7.

Area C is adequately served by highways, railroads, airlines, and water-based transportation. Portland is the largest fresh water port, and leading dry cargo port on the Pacific Coast. Other ports which support deep-draft commerce include Astoria, Coos Bay, and Yaquina Bay. Inland waterways serve a large portion of Area C and feed into Portland and Astoria from both the Columbia and Willamette Rivers. Portland is the northern terminus of the Southern Pacific Railroad and a western terminus for the Union Pacific and Burlington Northern Railroads. Area C is traversed in a north-south direction by Interstate Highway 5 and in an east-west direction by Interstate Highway 80N. Other Federal and State roads crisscross the area. Air service is available at several communities; Portland International Airport handles the great majority of air traffic and is on numerous national and international flight schedules.

Water resource development to date has been primarily for irrigation, flood control, hydroelectric power, and navigation. Nearly 1.3 million acres of irrigation account for about 88 percent of the total consumptive-use of water in the area. Hydroelectric power developments are concentrated at the four dams on the Columbia River which have an installed capacity of 4,372,000 kilowatts.

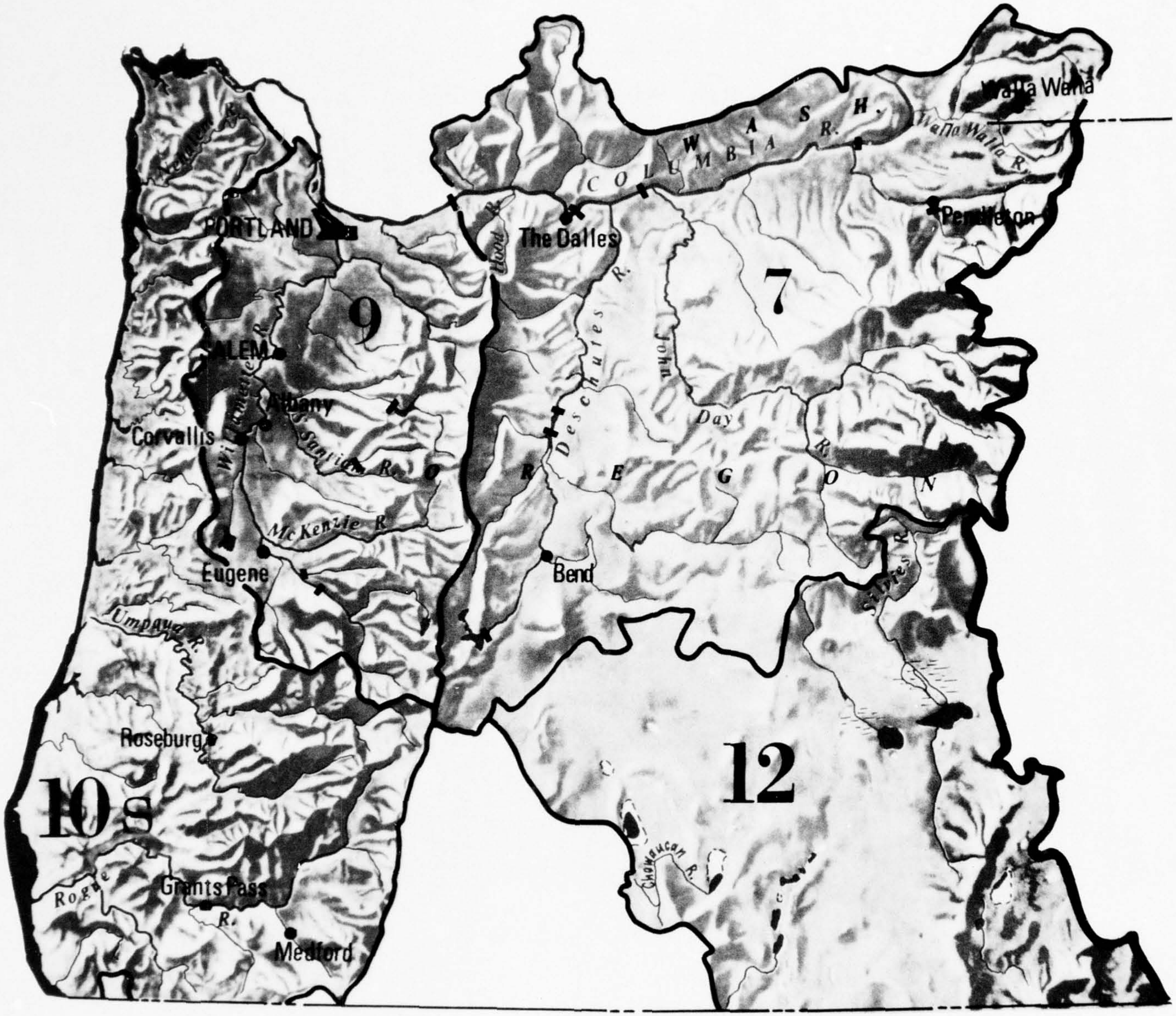


FIGURE 16. Plan Formulation Area C

Table 76 - Needs Summary, Area C, Columbia-North Pacific Region

Purpose or Function	Units	Current (1970) Development	Projected Gross Needs 1980	2000	2020	Residual Needs 1980	2000	2020
Water Development and Control								
Electric Power								
Capacity (Peak)	mw			Only Projected on a Regional Basis				
Energy	mil kwh			" " " " " "				
Navigation								
Commerce	1,000 tons	17,040	26,100	31,000	41,300	9,060	13,960	24,260
Water Quality Control								
Raw Waste Production 1/	1,000 p.e.	10,018	11,297	15,642	20,918	1,279	5,624	10,900
Waste Removal 1/	1,000 p.e.	7,677	9,602	14,078	18,826	1,925	6,401	11,149
Municipal and Industrial Water								
Supply	mgd	801	1,082	1,535	2,172	281	734	1,371
Municipal	mgd	(316)	(463)	(716)	(1,131)	(147)	(400)	(815)
Industrial	mgd	(432)	(554)	(736)	(940)	(122)	(304)	(508)
Rural-domestic	mgd	(53)	(65)	(83)	(101)	(12)	(30)	(48)
Flood Damages								
Major Streams 2/	Ann. $1,000	10,552	-	-	-	14,790	25,827	47,836
Bank Erosion 2/	Ann. $1,000	2,744	-	-	-	2,948	3,408	3,711
Areas Flooded 2/	1,000 ac	674	-	-	-	674	674	674
Irrigation								
Total Irrigated Area	1,000 ac	1,292	1,845	2,369	2,813	553	1,077	1,521
Water Short Area	1,000 ac	(602)	-	-	-	(602)	(602)	(602)
Water Supply	1,000 ac-ft	4,227	7,121	8,455	9,767	2,894	4,228	5,540
Water and Related Land Programs								
Fish and Wildlife								
Commercial Fishery	1,000 lbs	20,874	32,496	43,053	56,020	11,622	22,179	35,146
Sport Fishing	1,000 days	4,885	7,323	9,747	12,962	2,438	4,862	8,077
Resident Species	1,000 days	(3,030)	(4,230)	(5,646)	(7,587)	(1,200)	(2,616)	(4,557)
Anadromous, Marine, Shell	1,000 days	(1,855)	(3,093)	(4,101)	(5,375)	(1,238)	(2,246)	(3,520)
Hunting	1,000 days	2,526	3,173	4,389	5,621	647	1,863	3,095
Water Related Recreation								
Development	1,000 rec days	30,400	47,500	82,300	144,400	17,100	51,900	114,000
Reg. Surface Water Use 3/	acres	79,100	121,200	206,200	357,200	42,100	127,100	278,100
Land Area (Rec. Facility Development)	acres	9,400	27,500	48,300	90,800	18,100	38,900	81,400
Pleasure Craft	no. (1,000s)	107	159	313	584	52	206	477
Watershed Management								
Flood Damages--Minor Streams 2/	Ann. $1,000	6,155	-	-	-	7,885	10,962	15,527
Area Flooded 2/	1,000 ac	672	-	-	-	672	672	672
Erosion and Sediment Control	1,000 ac	3,519	5,303	8,086	11,298	1,784	4,567	7,779
Drainage	1,000 ac	217	359	545	734	142	328	517
Beach Erosion Control	miles	-	-	-	-	27	27	27
Bank Stabilization	miles	565	1,811	3,309	4,766	1,246	2,744	4,201
Levees and Floodwalls	miles	295	772	1,424	2,078	477	1,129	1,783
Channel Improvement	miles	1,695	4,502	7,243	9,426	2,807	5,548	7,731
Protection and Management 4/	1,000 ac	32,429	33,669	34,296	34,394	26,847	27,474	27,573
Water Conservation	1,000 ac	1,255	1,799	2,305	2,760	544	1,050	1,505
Water Yield Improvement	1,000 ac	0	20	52	109	20	52	109
Related Land Production								
Croplands	1,000 tons	4,692	6,061	7,523	9,676	1,369	2,831	4,984
Irrigation	1,000 tons	(2,241)	(3,573)	(5,393)	(7,600)	(1,332)	(3,152)	(5,359)
Dryland	1,000 ons	(2,451)	(2,488)	(2,130)	(2,076)	(37)	(-321)	(-375)
Forest Wood Fiber	mil cu ft	1,821	1,809	1,932	2,020	-12	111	199
Range Grazing Capacity	1,000 aum	2,086	2,543	3,227	3,941	457	1,141	1,855

1/ Includes municipal, industrial, and recreation use.
2/ Needs over 1970 level of flood prevention.
3/ Needs are a function of recreation day requirements.
4/ Includes recurrent programs that will require acceleration with implementation of a plan.
Residual needs cannot be determined by subtracting current development from gross needs as many of these practices are applied annually on the same areas.

Hydroelectric power is also produced in the Willamette, Deschutes, Hood, White Salmon, North Umpqua, and Rogue drainage basins. Reservoirs on the Columbia and Willamette Rivers also provide space for flood control and water for navigation and other purposes.

The resource needs are summarized in table 76. The water and land areas required to satisfy the recreation needs and to maintain the natural environment are shown in terms of acres; scenic rivers and roads requiring further study are shown in miles. Fish and wildlife needs are expressed in terms of use and facility requirements. Flood control needs, expressed in dollars of projected annual damages, and waste treatment expressed in population equivalents, are the two functions not shown in terms of units of water and land.

Much of the land is highly erosive, and intensive land treatment measures must be employed to protect this resource and assure its capability to produce projected food and fiber needs. This is exemplified by the extensive acreages requiring various practices shown under watershed management.

Formulation of Area Plans and Programs

There are a variety of opportunities to meet water and related land resource needs. The rationale and results of the plan formulation process for the area are summarized in the following sections by river basin. In the basin discussions, the needs, conflicts, full range of developmental opportunities, and the recommended plan, program, or study, together with primary alternatives and the reasons for the proposed action, are discussed. The following paragraphs summarize recommended plan elements which generally are integral parts of the framework plan for all basins, even though not discussed specifically with respect to each basin.

The maintenance and enhancement of the environment were considered in formulation of basin plans. Every effort was made to meet identified needs without recommending structural measures which would encroach upon those streams identified in the Recreation and Fish and Wildlife Appendices for consideration for preservation. Although not identified individually in all cases, preservation or protection of wilderness and primitive areas, historic and unique areas, and areas adjacent to scenic roads and recreation rivers is included in the plan.

The plan provides that municipal and industrial wastes be treated to remove 85 percent of organic materials by 1980 and 90 percent by the years 2000 and 2020. The plan also includes measures and facilities to minimize the adverse effects of recreation and watercraft wastes, irrigation return flows, feedlot wastes, other harmful land runoff, and algae. In addition, the plan

provides streamflow augmentation in areas where waste treatment alone would not result in adequate stream quality.

In meeting irrigation needs, consideration was given to private development as well as Federal and federally assisted projects. In general, private development was estimated on the basis of past performance and the probable opportunities for such development in each river basin. Identified projects considered to have a reasonable probability of implementation were then added to meet the remaining and generally major part of the needs. The river basin plans discuss these projects but, in most cases, do not identify the anticipated private development. Total irrigation (private and other) is discussed in greater detail in the irrigation portion of the Area Plans and Programs Section.

Electric power needs were determined on a regional basis; consequently, consideration of electric power in the area plan is limited to a few hydro projects plus the degree of necessary thermal development determined by the regional analysis. The thermal developments are not located specifically within each river basin.

The plan includes a combination of management techniques, land treatment practices, and structural measures to maintain and improve soil and water resources of the area. Many different practices may be required on the same land and some measures may be recurrent during the planning period. Within the wide range and combination of these measures and practices, a number of alternatives are possible; therefore, the plan recommends further studies to develop specific alternatives. The amount of the land treatment measures that is expected to be accomplished by projects is included in the plans for the individual basins; however, the extent of the accomplishment of these measures by individual landowners under the ongoing programs is included only in the tables and later discussion of the land measures and watershed treatment function.

With respect to municipal and industrial water requirements, the plan provides for expansion of present facilities or incorporation of municipal and industrial water supply as a function of multiple-purpose surface storage projects where needed.

The general plan for the coastal zone and estuaries is oriented toward a balancing of the conservation and development of the natural resources. Within the limits of detailed knowledge of coastal zone management, the framework plan recommends specific measures. Where such specificity is not possible, the plan recommends studies to determine the courses of future action.

General consideration was given to meeting flood damage reduction needs through both structural and nonstructural measures. To the extent deemed reasonable, the framework plan includes flood control storage projects, levee construction, and channel modification to meet a portion of the identified needs. Flood plain management measures such as flood plain use regulations and flood proofing are recommended to augment flood control measures or when such measures are not feasible.

Navigation measures included in the plan to meet anticipated needs include harbor and port facility improvements, channel maintenance, and lock enlargements. An integral element of all recommended maintenance dredging programs is a coordinated plan for disposing of spoil material in such a manner as to minimize adverse effects. Recommended expansions of existing small boat facilities and the addition of new Columbia River harbors of refuge, although not located specifically, are parts of the plan. Lower Columbia River channel work and State of Washington port improvements are included in the plan for Area D.

Fishing needs generally would be met by providing a variety of fishing experiences through increased numbers or size of fish, more intensive use of some species, and providing more fishing areas. Major categories of plan elements to satisfy the area's fishing needs include habitat preservation and enhancement, improved access, artificial propagation, and maintenance of certain natural fish stocks.

Hunting needs generally would be met by sustaining and increasing natural production and augmentation of supply. Major categories of plan elements to satisfy the area's hunting needs include habitat preservation and improvement, greater harvest of the existing resource, and artificial propagation and feeding.

Although the Recreation Appendix provides greater detail, the area's recreation needs would be met by such categories of plan elements as protection of recreation resources, development of the existing supply of land and water areas, rectifying use imbalance by redistribution, lengthening the recreation season, and encouraging different types of uses.

Hood Subarea (Subregion 7)

The Hood Subarea is primarily an agricultural and forest area of about 1,000 square miles in the northwest portion of the subregion (figure 17). Average annual runoff from the basin is about 1 million acre-feet, about 90 percent contributed by Hood River and the remainder by Fifteenmile Creek and several smaller streams. The ground-water resource is largely undetermined, although several

areas with known yields of 100 to 500 gallons per minute and 500 to 2,000 gallons per minute have been identified.

Streamflow depletions during the annual low flow period have reduced the number of anadromous fish spawning in Hood River and several of the smaller streams. Low flows impair fish passage at the Powerdale diversion on Hood River, the East Side Irrigation Company's diversion on East Fork Hood River, and in the lower reaches of Eightmile and Fifteenmile Creeks. Access is also needed past a cascade on West Fork Hood River.

The recreation attractions are Bonneville Dam and fish hatchery, Lost Lake, The Dalles Dam, Mt. Hood, the Columbia River Gorge, and the fruit orchards of Hood River Valley. Water surface for recreation is adequate, and it is believed that future needs can be met by expansion of facilities and accessible shoreline areas.

Flood damages are limited in the Hood River system because most of the streams flow in deep, rock-walled canyons with little development. About 800 acres of cropland are flooded frequently in the Hood River system. About 3,300 acres along Fifteenmile and Eightmile Creeks have flood problems, and the stream channels are severely eroded. Storage projects with flood control as a benefit should be a part of all project considerations.

A total of 41,800 acres is irrigated in the subarea, about 90 percent from surface water supplies and 10 percent from wells. Most of the land is adequately supplied, although 5,900 acres, served primarily from wells, need additional water. In addition, the basin contains over 200,000 acres of potentially irrigable land, a large portion of which lies in the eastern part of the basin between Eightmile Creek and the Deschutes River above 1,000 feet in elevation. Future development of this land is of questionable economic justification.

The need for municipal and industrial water is projected to increase about 2-1/2 times by 2020. Most of the present supply is from surface sources, and few potential problems are foreseen in meeting future demands from available surface and ground-water supplies.

Present waste treatment is relatively poor. Hood River is affected by bacterial contamination, depressed oxygen levels, and excessive algae blooms and aquatic growths. The primary contributor, the lumber and wood products industry, is not expected to expand significantly.

Development opportunities in Hood Basin are few, primarily because stream gradients are generally too steep to offer desirable

reservoir sites. Consequently, emphasis in the plan is placed upon nonstructural measures and development of the few storage sites which are available on smaller tributaries. Irrigation of major blocks of land by pumping from either the Deschutes or Columbia Rivers was also considered but appears to be of limited potential because of the high lift involved and the legal restraints on use of Lower Deschutes River flows.

1970 tc 1980 Program The plan for the 1970-1980 period includes multiple-purpose storage totaling 58,300 acre-feet on Fifteenmile Creek, Eightmile Creek, East Fork of Hood River, and Green Point Creek. These watershed projects would provide irrigation water for 8,800 acres of new lands and firm up supplies on presently irrigated lands. Flooding would be reduced on Fifteenmile and Eightmile Creeks and minimum flows provided in both streams for fish. Over 48,000 acres would be treated to control erosion, thereby protecting structures and water from sediment damage. About 2,800 acres of cropland would be drained to allow diversified cropping.

Other programs and private development would meet projected needs for municipal and industrial water supply, water quality, recreation, land treatment, fish, and wildlife functions. Fish passage would be provided on West Fork of Hood River during this time period and the low flow problems at Powerdale alleviated. Although no streams are proposed for preservation, a number of wildlife areas have been identified which should be protected. In addition to ongoing wildlife management programs, special funding is needed to purchase or lease 10,000 acres of key wildlife habitat, improve 15,000 acres of habitat, and construct 30 miles of fence to protect wildlife habitat.

Long-Range Program No structural measures are proposed in the 1980-2000 period. In the next 20 years, two small watershed projects are included in the plan. Also, water supplies to irrigate 1,900 acres of new lands would come from the Columbia River and storage (5,100 acre-feet) on Mosier Creek. Erosion control practices would be applied on over 4,000 acres of cropland, and 700 acres of cropland would be drained.

Municipal and industrial water would continue to be supplied by local efforts as would some irrigation development and other agricultural enterprises. Agency programs generally fill the voids remaining after private efforts. If properly funded, such programs, which encompass nearly all of the functions, can provide needed facilities for recreation, fish and wildlife, and other fields and enhance and maintain the environmental quality of the area.

COLUMBIA-NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

PLAN FORMULATION SUBAREAS

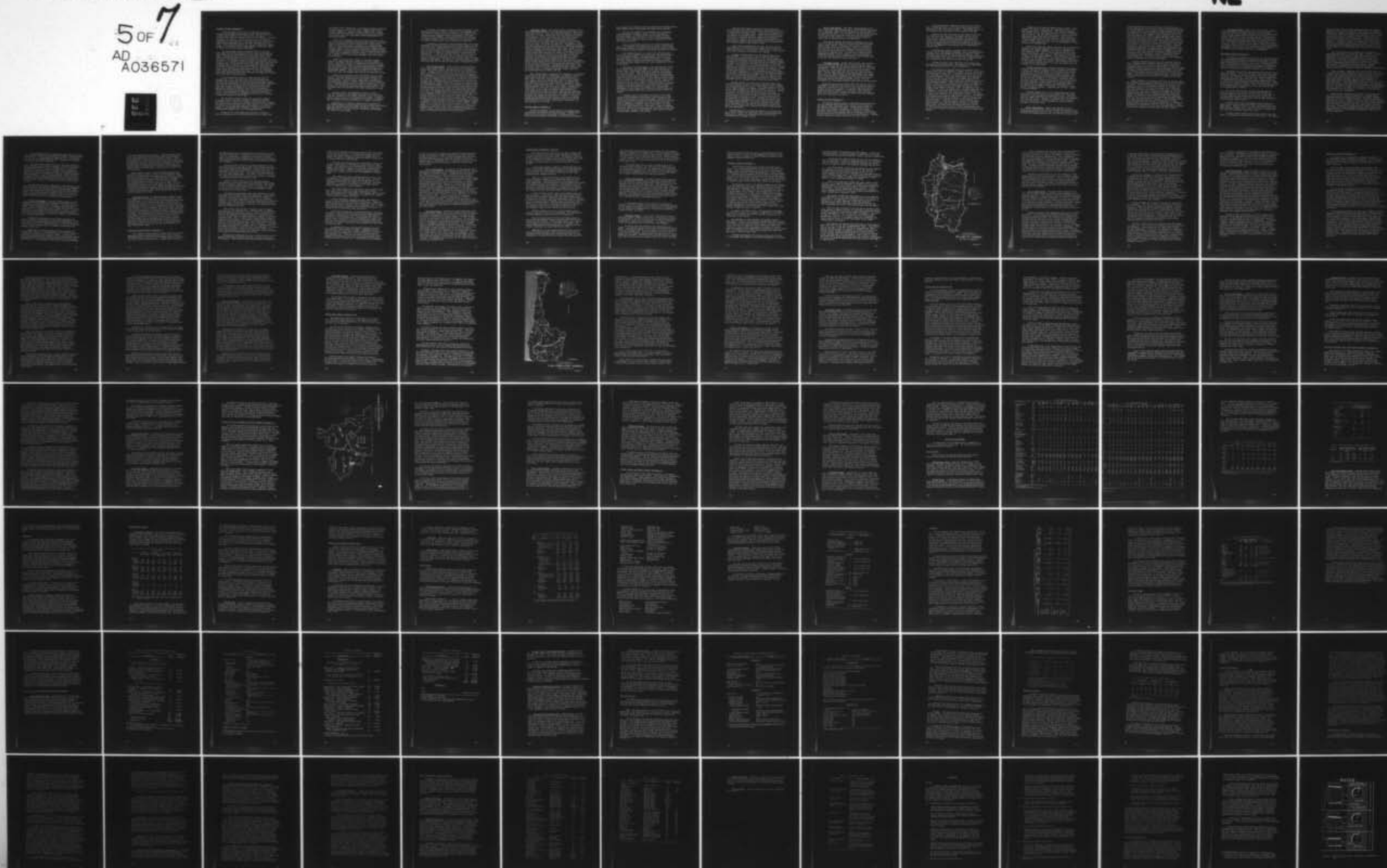
MID COLUMBIA SUBREGION 7

FIGURE 17

AD-A036 571 PACIFIC NORTHWEST RIVER BASINS COMMISSION VANCOUVER WASH F/G 8/6
COLUMBIA-NORTH PACIFIC REGION COMPREHENSIVE FRAMEWORK STUDY OF --ETC(U)
JUN 72 E J GULLIDGE, H H RALPHS, C STEWART

UNCLASSIFIED NL

5 OF 7
AD
A036571



Deschutes Subarea (Subregion 7)

Deschutes Subarea covers about 10,500 square miles and includes the drainage of the Deschutes River and its tributaries (Crooked River, Metolius River, White River, and others). Average annual runoff of Deschutes River near its mouth is 3,755,000 acre-feet, or 5,186 cfs. Several storage reservoirs have been constructed on the headwaters of Deschutes River and Crooked River, primarily for irrigation, and on the lower Deschutes River for power. Ground-water development has not been significant, largely because it is available only in small amounts in some areas while in others its depth discourages development.

The Warm Springs Indian Reservation, which is entirely within the basin, covers roughly a 35 mile square area extending from Deschutes River westward nearly to the crest of the Cascade Range. Warm Springs River, Mill Creek, Whitewater River, and portions of Lake Simtustus and Billy Chinook Lake are within the reservation. In addition to fish and wildlife, recreation, and timber resources, the reservation contains several large blocks of potentially irrigable land. At the present time no plans have been identified to irrigate these lands, and it is estimated that other water needs can be met from within the reservation. However, existing water rights of the Warm Springs Indian Reservation must be considered in the planning of Deschutes River Basin. In the lower Deschutes River below the Indian reservation, the State of Oregon has withdrawn waters from further appropriations.

The Deschutes River basin is a prime fishing area for resident fish. Until the late 1950's, the Metolius and Lower Deschutes Rivers were also excellent habitat for anadromous fish; but since the construction of Pelton and Round Butte Dams, anadromous fish runs have been limited to the Lower Deschutes River system. Fish needs include flow augmentation, habitat preservation and improvement, removal of barriers, and artificial propagation. The key to meeting future hunting needs rests heavily on preservation of existing habitat and provision of additional habitat to provide a base for intensive management activities and to furnish a place for the public to participate.

The Deschutes Subarea includes some of the more popular recreation areas in the State of Oregon. Among these are the many lakes in the Cascades, the Deschutes and Crooked River canyons, the Metolius River, and other clear water streams. With this variety of assets, the need for additional water surface is not critical; rather, it is more important to maintain a balance between free flowing stream segments and slack water opportunities.

Because of its even flowing characteristics, Deschutes River has practically no flood history except for the major flood

of December 1964. Damages were to railroad and highway facilities along the lower 85 miles of the river. Damages also occurred on some tributaries. Solutions could include storage, zoning, continued channel maintenance, diversion of water to sink holes in the porous lava rock, and proper watershed management with necessary treatment.

About 1871, irrigation began on a small scale near Sisters, and in the intervening years it has grown with private and Federal project construction to 256,400 acres of land. High seepage losses in canals and laterals contribute to a relatively high total of 1,264,000 acre-feet diverted annually to supply presently irrigated lands. To meet projected needs, about 70,000 acre-feet of water would be required annually to provide supplemental supplies to the basin's inadequately irrigated lands. Also, a portion of its 1,482,000 acres of potentially irrigable land would require water supplies.

About 26,700 acre-feet of water is diverted or pumped annually to supply municipal, industrial, and rural-domestic users. Projections indicate the population will double by 2020 and that municipal use, which now totals 9,100 acre-feet annually, will more than triple. Water supplies would generally be available through increased diversions of streamflow and additional ground-water pumping. Areas in the vicinity of the towns of Prineville, Bend, and Redmond could benefit from upstream storage.

Waters of the Deschutes River and tributaries are of high quality. Most municipalities utilize effective treatment and disposal practices, allowing only a small amount of wastes to enter waterways. However, several communities, including Bend, the largest municipality, dispose of untreated wastes in lava sink holes. Although satisfactory with regard to surface water, this practice will eventually contaminate ground-water supplies. Once the ground water is polluted, it may remain unusable for a long time.

The most serious land management problem is erosion, with over 80 percent of the damage occurring in the lower basin below the confluence of Crooked and Deschutes Rivers. Protection against erosion of topsoil, accumulation of sediment on highways and in drainage ditches, and pollution of streams is necessary.

Opportunities to maintain a high quality environment in the Deschutes Basin at least through the next 50 years are excellent. Needs for additional water have been identified in only three functional areas: fish and wildlife, irrigation, and municipal and industrial water supply.

Potential new sources of water to meet requirements include bypassing an eight-mile reach of Deschutes River upstream from Bend which has seepage losses of 35,000 acre-feet annually, and lining existing irrigation canals and laterals to save about 250,000 acre-feet annually. Other possibilities are utilizing unassigned storage in Prineville Reservoir of 82,500 acre-feet, drilling for ground water, and constructing new reservoirs.

Alternatives considered included nondevelopment and several multipurpose plans which would provide new water supplies to meet projected needs. Nondevelopment does not appear to be viable in view of the projected water needs. Nearly all of the multipurpose plans involved storage and the primary problem was determining which streams or reaches of streams should be retained free of impoundments. It was concluded that the main stem of Deschutes River, as well as certain other selected streams, is a unique valuable resource and could provide the greatest benefit by being managed in that manner. Consequently, a proposed eight-mile bypass canal upstream from Bend was not considered a viable alternative.

<u>1970 to 1980 Program</u> Prior to 1980, the plan includes three small storage projects, preservation of five streams, one channel improvement project, and other measures of a program nature. Storage totaling 31,800 acre-feet on Trout Creek, Willow Creek, and South Fork of Crooked River would provide irrigation water supplies for 7,100 acres of new lands and firm up supplies on 3,300 acres already under irrigation. In addition, the projects would reduce flooding on 2,600 acres of rural and over 600 acres of urban land. Drainage would be accomplished on 2,200 acres of cropland, and over 60,000 acres would be treated to reduce erosion and sedimentation damages. Basic fish and wildlife habitat would be assured by preservation of special wildlife areas and the free flowing portions of Deschutes River, Metolius River, Quinn River, Little Deschutes River, and Crooked River downstream from Prineville Dam. Fish passage facilities at the falls on White River and a tributary, Jordan Creek, are included in the plan and would provide anadromous fish access to a new stream system. Fish passage facilities are also included for three small dams on the Deschutes River and one on the Little Deschutes River. In addition to ongoing wildlife management programs, special funding is needed to purchase or lease 22,000 acres of key wildlife habitat, improve 35,000 acres of habitat, and construct 34 miles of fence. Flood damages in the Prineville area would be reduced by a flood plain management program and a small channel improvement project in Juniper Canyon. Further studies are necessary to determine the nature of additional Crooked River flood protection.

Long-Range Program The Central Division, Deschutes Project, would provide the nucleus of the 1980-2000 plan which consists of four major reservoirs, three small watershed projects, and related facilities. In total, 408,000 acre-feet of storage are included for development in this time period with about three-fourths concentrated in two reservoirs, Big Marsh and Big Prairie. The remainder of the storage would be located in Beaver Creek Reservoir, Monner Reservoir, and three watershed projects (Tygh Creek, Hay Creek, and Prineville Reservoir). Supplemental irrigation water supplies would be furnished to the remaining inadequately supplied lands and full supplies to 18,800 acres. Another 49,700 acres of irrigated land are deferred until after 2000 to meet the projected development of that time period. Other project considerations include flood prevention on 2,600 acres of rural land and reduction of erosion on 97,200 acres in the upper watersheds. Recreation and resident trout fishing opportunities, already plentiful, would be further enhanced by the new reservoirs. Big Marsh and Big Prairie Reservoirs alone would create 16 square miles of water surface above 4,000 feet in elevation. Minimum flows of 100 cfs below Wickiup Dam would be provided and summer flows below Bend would be improved. Recommended minimum fishery flows of 5,000 to 6,000 cfs in the lower Deschutes River could not be met in most years. Preliminary hydrologic studies indicate a year-round deficiency of about 1,500 cfs.

Nine storage projects, primarily for irrigation, are included in the plan for the 2000 to 2020 period. One would be on White River and the remainder in the following watershed projects: Squaw Creek, Rock Creek, Warm Springs, Antelope Creek, Arnold I.D., Lapine, Ochoco, and Twelve Mile Creek. It appears that about 105,000 acre-feet of storage should be included in these projects to meet projected needs. Full irrigation water supplies would be provided to 72,200 acres of new lands. Drainage would be provided for 1,600 acres of cropland, flooding reduced on 3,900 acres of rural land, and erosion damage minimized on over 118,000 acres of upper watershed. Municipal and industrial needs would be met from local sources until sometime after 1980, at which time storage for Prineville is included in the plan. Throughout the planning period, private initiative and regular agency programs would be vital elements if projected needs for recreation, fish and wildlife, water quality, irrigation, and land treatment are to be met.

John Day Subarea (Subregion 7)

The John Day Subarea, with an area of 7,840 square miles, lies between the Deschutes and Umatilla Basins. Average annual runoff of the John Day River is about 1,400,000 acre-feet. On the basis of available information, the ground-water resources

do not appear very extensive, with the exception of the lower portion where yields of 100 to 500 gallons per minute can be expected.

The river has annual runs of anadromous fish, including spring chinook and steelhead. There is also a substantial resident fishery. The major problems are seasonal low flows, high water temperatures, and silt. Access is also needed past two barriers, a rockslide on Big Creek and a waterfall on South Fork of John Day River.

There is considerable potential for increased hunting; however, it is dependent to a large extent on access. Winter range for big game animals is critical and water projects which encroach on it without mitigation measures could seriously affect the resource.

Even though Subregion 7 as a whole has sufficient water surface area for recreation until after 2020, the John Day Basin has a noticeable shortage, and impoundments of water could be extremely beneficial from a recreation standpoint. To provide the widest range of water-based recreation, a balance between free flowing stream segments and slack water opportunities should be maintained.

The majority of flood damages in the John Day Basin occur in the extensively cultivated upper valley from Prairie City to Picture Gorge. From Picture Gorge to its mouth, the John Day River is in a narrow, deep valley where potential flood damages are relatively minor. About 178,000 acre-feet of storage space is needed to fully protect the reach from Prairie City to Picture Gorge, including 28,000 acre-feet on both Canyon and Beech Creeks. About 6.2 miles of levee would be required near Mt. Vernon along the John Day River. Also, about 1.6 miles of levee would be required at Mt. Vernon to protect it from Beech Creek, a northside tributary, and other channel and levee works would be needed to adequately protect Prairie City, Canyon City, and Dayville. Developments on the Canyon Creek flood plain between Canyon City and John Day require regulation to minimize growth of potential damages.

Irrigated lands are generally restricted to the stream valleys with the greatest concentration located along the John Day River from Prairie City to Picture Gorge. There are some 71,500 acres presently irrigated, of which 53,500 acres are inadequately supplied. In addition, the basin contains 1,032,600 acres of potentially irrigable land, a large portion of which lies on the high benches in the lower basin. High lift pumping from Lower John Day or Lake Umatilla for irrigation of these high benches is not included in the framework plan, primarily because of questionable economic justification.

Most municipal supplies are derived from ground water. Local shortages result from inadequately sized distribution works or inadequately developed sources. Ground water probably will continue to be the primary source. Lumber and wood products are the primary water using industry. Most of the mills have their own sources of supplies and do not depend on municipalities. Future use is expected to be self-supplied from surface sources. Rural-domestic supplies are generally obtained from ground water and livestock supplies from surface sources.

Waste loads discharging into the John Day River are not large; however, low flows during the summer result in water of undesirable quality in some reaches. Projections to 2020 indicate only a small increase in potential waste loading.

A number of alternatives exist for meeting needs in the John Day Basin. Recent studies indicate that a significant potential for producing peaking power exists through storage on the Lower John Day River consisting primarily of a pumped storage hydroelectric development with reservoirs at the Emigrant, Mikkalo, and Butte Creek sites and utilizing Lake Umatilla as the lower reservoir. In addition to creating considerable power for peaking purposes, the reservoirs would provide some flood control, a large water surface area for recreation, and water for irrigation at possibly lower pumping costs. This alternative was not included in the plan, inasmuch as it has significant environmental conflicts and the State of Oregon has included most of the Lower John Day River in its Scenic Waterways System. There also appears to be ample justification for studying the potential of incorporating the reach into the national system of wild and scenic rivers.

Storage possibilities exist in the upstream reach of the John Day River and on several tributaries where potential damages to the environment would be minor. This storage could be used to meet irrigation demands, to augment streamflows during the low flow season, and to provide water surface area for recreation. Storage on the main stem North Fork John Day River does not appear justified as it would adversely affect recreation and fish and wildlife values and provide insufficient flood protection and other benefits to justify its cost. Storage on tributaries of the North Fork of John Day River is an alternative which could further increase streamflow in the lower John Day River during the summer and fall months. One of the reservoir sites would be on the Middle Fork. The plan for preserving the North Fork would not be affected while supplying increased storage benefits for flow augmentation.

Nondevelopment for the John Day Subarea was considered but was rejected, because the significant needs for additional water which exist in nearly all functional areas can be met with environmentally acceptable measures.

1970 to 1980 Program Four small storage projects in the Butte Creek, Rock Creek, Mountain Creek, and Strawberry Creek areas, with an aggregate capacity of 40,300 acre-feet, are included in this phase of the plan. The four federally assisted projects would provide supplemental water for 8,400 acres and full supply for 6,300 acres of new irrigation. Flooding would be reduced on 5,900 acres of rural and 30 acres of urban land.

Other agency programs and private development would meet projected needs in the fields of municipal and industrial water supply, water quality, recreation, flood control, irrigation, land treatment, and fish and wildlife. Some of the specific measures would be a flood plain management program for Canyon City and fish passage facilities at barriers on Big Creek and South Fork of John Day River. In addition to ongoing wildlife management programs, special funding is needed to purchase or lease 76,000 acres of key wildlife habitat, improve 56,000 acres of habitat, and construct 315 miles of fence.

Long-Range Program Between 1980 and 2000, five reservoir projects totaling 94,000 acre-feet of capacity and one 8-mile levee project along John Day River downstream from Mt. Vernon are contemplated. These include the Hall Hill site on the main river near Prairie City and reservoirs in the Grass Valley Canyon, Upper John Day, Upper South Fork John Day, and Long Creek watersheds. Project considerations include supplemental water supply for about 16,000 acres, irrigation of about 11,000 acres of new lands, 2,000 acres of cropland drainage, 2,600 acres of flood prevention, and 110,000 acres of erosion control. Private development and other agency programs would continue in this period.

During the last period, between 2000 and 2020, the rate of development is expected to decline and only two reservoir projects (Haystack Creek and Fox Creek), with a total capacity of about 19,000 acre-feet, are planned. In addition, levee projects are planned at Dayville, Canyon City, and Prairie City, totaling about 4 miles in length. Private development and agency programs would also continue in this period.

Umatilla Subarea (Subregion 7)

The Umatilla Subarea occupies 4,000 square miles between the John Day and Walla Walla Basins and includes the watersheds of the Umatilla River and Willow Creek. Average annual runoff of the streams at Pendleton and Heppner are 355,000 and 12,000 acre-feet, respectively. Ground water is generally available in the basin with the most abundant supplies occurring in the northern portion from Willow Creek eastward to just beyond Hermiston. However, natural recharge is limited, as much of the area is arid.

Umatilla Subarea is inhabited by most types of wildlife; and, if projected needs are to be met by 2020, hunting opportunities will have to be nearly doubled. The primary need is for the expansion and improvement of winter range for big game.

Before 1914, runs of spring and fall chinook salmon and steelhead trout were reported in the Umatilla River system. Also, in early times, anadromous salmonids were reported in Willow Creek. Subsequent diversions and developments have limited the production of anadromous fish; however, potential remains to regain a portion of the past production of anadromous fish if flow augmentation and passage can be accomplished on Umatilla River.

Existing water rights, including those of the Umatilla Indians, must be considered in planning. Both the Umatilla River and McKay Creek flow through the 95,000 acre Umatilla Indian Reservation where there is a growing need for domestic industrial, and recreational water supplies. In addition, irrigation water may be needed for as much as 40,000 acres of dry land.

The Umatilla Basin lacks sufficient water surface area for projected recreation needs. Development of new impoundments with recreational facilities would be beneficial.

The sixth most disastrous flood in the history of the United States from the standpoint of number of lives lost occurred on Willow Creek in June 1903. A cloudburst caused an estimated peak discharge of 36,000 cfs, resulting in 247 lives lost in the vicinity of Heppner. Since that time, Heppner has redeveloped in its former pre-flood location on the canyon floor and has suffered extensive damages from significant floodflows which recur with alarming frequency. About 14,000 acre-feet of storage is needed to fully protect the Heppner area; however, an authorized project with 11,500 acre-feet of storage would protect from damages of the amount occurring in 1903. In addition to such storage, about 2 miles of channel work is needed through the town of Heppner. Flood runoff from Umatilla River and tributaries is not as spectacular but does cause annual losses in the form of erosion and inundation of developments and crops. The majority of flooding occurs along the Umatilla River about 10 to 25 miles downstream from the town of Pendleton. A total of 232,000 acre-feet of storage is necessary to fully protect Pendleton and downstream areas. A multiple-purpose reservoir on the upper Umatilla River, Ryan Dam, and smaller structures on Tutuilla, McKay, Birch, and Stage Gulch and channel and levee work on the Umatilla River in the vicinity of Echo and Wildhorse Creek at the towns of Adams and Athena could significantly reduce flood damages.

Irrigation in the Umatilla Subarea began as early as 1862, primarily to provide a feed base for ranching interests, and has increased since to 65,900 acres. Most lands are supplied from surface sources, and nearly half do not receive an adequate supply of water. The area contains almost 1.4 million acres of high quality land which could be irrigated. Water could be supplied by pumping from the Columbia River, from ground water, or from storage. There are some potential combination thermal electric and irrigation projects. One such development is being studied in the Boardman area.

Water use by municipal, major industrial, and rural-domestic consumers will increase significantly; studies indicate that Pendleton, the largest community, will need to supplement its water supply by 1975. The city has an application for a water right on the Umatilla River and, in conjunction with upstream storage, could meet future demands. Other communities are expected to continue to use ground water. The lumber and wood products industries are not expected to expand significantly; consequently, no water supply problems are expected. Rural-domestic water use is projected to increase about 2-1/2 times, but ground water can continue to meet this demand.

Although municipal waste treatment facilities are generally adequate, some need for expansion of local treatment facilities is evident as effluent discharge to the Umatilla River reaches unsatisfactory levels during the food processing season. The community of Heppner has an adequate secondary treatment plant, but at times the facility must discharge its effluents into a dry Willow Creek streambed. At Pilot Rock, stream pollution is avoided by the lumber manufacturing industry by utilizing wastes for crop irrigation. Stream conditions are generally good in the upper reaches of Umatilla River, but downstream reaches are affected in the summer with bacterial contamination, algal blooms, and aquatic growths. Windblown soils are also a source of stream sediments.

It became apparent early in the formulation process that, if all needs were to be met, the water supply within the basin would have to be supplemented from outside sources. Diversions from the Columbia River and from the John Day River Basin appeared to be the most likely. Storage on the Umatilla River system was also recognized as a need, although its location involved evaluation of several sites.

<u>1970 to 1980 Program</u> Federal and federally assisted projects are expected to fill the gap between anticipated private accomplishments and projected needs. Included are projects already identified by planning agencies and those for which a need can be

seen but planning has not been initiated. Construction of a multiple-purpose dam and reservoir on Willow Creek upstream from the town of Heppner and an improved channel through the town has been authorized. These developments would prevent an estimated 86 percent of the total damages in the Willow Creek Basin. By 1980, the Umatilla Basin Project would supplement water supplies for 18,000 acres of presently inadequately supplied lands and bring under irrigation 102,000 acres of dry lands of which about 5,100 acres are Indian trust lands. The project should considerably enhance the recreation resources by creating and providing public access to about 8,000 acres of water surface. Proposed reservoirs in the plan would also benefit fish and wildlife by providing minimum pools to support fish, flow augmentation, and temperature control on the Umatilla River, enabling it to regain some of its lost salmon runs and providing nesting habitat and attraction water for waterfowl. Project streamflows, coupled with adequate waste treatment facilities, would meet water quality objectives. The project would reduce but not completely eliminate flood hazards on the major streams.

Six small watershed projects are also included, Tutuilla Creek, Wildhorse Creek, Boardman, Sixmile Canyon, South Butter Creek, and Rhea Creek, for the primary purpose of furnishing supplemental water for 2,800 acres and 21,300 acres newly irrigated cropland. Project considerations include drainage of 2,000 acres of cropland, flood reduction on 11,300 acres of rural and 120 acres of urban lands, and reduction of erosion and sedimentation damage on over 237,000 acres of upper watersheds. Also included in the six projects are facilities for recreation and fish and wildlife.

Local initiative is expected to meet some of the municipal and industrial water supply, irrigation, and flood control development needs. Projected municipal and industrial needs, with the exception of the city of Pendleton, would be met through local governmental agencies from available ground water. Pendleton's needs are expected to be provided for by the proposed Umatilla Basin Project. Most future irrigation development will require storage or high pump lifts; consequently, private efforts are expected to bring only a small amount of land under irrigation. Efforts in the field of flood plain regulation, although meager up to this time, would have to increase to prevent future developments from locating within the flood plains of Lower McKay Creek and Umatilla River upstream from Pendleton. In addition to ongoing wildlife management programs, special funding is needed to purchase or lease 82,000 acres of key wildlife habitat, improve 146,000 acres of habitat, and construct 270 miles of fence.

Long-Range Program Between 1980 and 2020, the projected needs for municipal and industrial water, fish, wildlife, recreation facilities, sewage treatment, and land treatment could be met through combined efforts of private and public sectors without construction of major storage projects. Columbia River would be the source of supply for about 70,000 acres of project-type irrigation development needed along the south side of the river. An additional 600,000 acres need land treatment measures to reduce erosion. The plan also includes 5 miles of channel and levee work on Umatilla River in the vicinity of Echo and Pendleton and another 5 to 6 miles of such work on tributary streams at the towns of Helix, Athena, Pilot Rock, and Stanfield.

Walla Walla Subarea (Subregion 7)

The Walla Walla Subarea, with an area of 1,760 square miles, lies in northeastern Oregon and southeastern Washington. Runoff of the Walla Walla River below the mouth of Touchet River averages about 400,000 acre-feet annually, or 555 cfs. Although ground water is available in much of the basin and properly constructed wells yield from 100 to 2,000 gallons per minute, overdraft is a problem in some areas and dependable supplies are not assured.

Steelhead trout are the only anadromous fish present in the Walla Walla River. Former runs of spring chinook and coho salmon have been eliminated by cannery pollution, unscreened irrigation diversions, and low flows. Steelhead trout survive because their migrations occur when river flows are high. Improved flows in the Walla Walla River downstream from Milton-Freewater would make it possible to reestablish spring chinook and coho salmon. Passage facilities also should be improved at Mill Creek Dam, the basin's only existing water storage project, and at two diversion dams on Yellowhawk and Mill Creeks.

One of the major factors in meeting hunting and other wildlife needs is the protection of prime wildlife habitat. The most important areas because of their value to deer and elk as winter range are the canyons from elevation 1800 to the national forest boundary, and Touchet River drainage from Dayton to the national forest boundary.

Suitably located water impoundments would increase the capacity for reservoir-related recreation, which presently is in short supply. However, the area is less than 40 miles from Lake Wallula on the Columbia River. None of the basin's streams have been selected as potential recreation rivers.

The most serious flooding occurs along Touchet River from Dayton to Waitsburg and along lower Walla Walla River. The primary

area in the Mill Creek drainage needing protection is a highly developed farming section along the 5-mile reach directly below Walla Walla. Damages are projected to increase nearly threefold by 2020 unless protective measures are undertaken. About 173,000 acre-feet of storage is necessary to fully control floods on the Walla Walla River and its tributaries. Reservoirs on Walla Walla River, Touchet River, and Mill Creek would provide such storage. To supplement control by reservoirs, levee and channel work at the following locations may be necessary: 10 miles on the Walla Walla River downstream from Milton-Freewater; 6 miles on the Touchet River at Waitsburg; and 8 miles on Dry Creek near Lowden.

The long growing season, together with irrigation, has encouraged production of a variety of crops. By 1970, irrigated lands comprised 27,200 acres in Oregon and 41,900 acres in Washington. A large portion of these lands, 16,100 acres in Oregon and 34,900 acres in Washington, do not receive a full water supply. The largest potential for further development exists in Washington where 580,400 acres of the total subarea's 658,400 acres of potentially irrigable lands are located. The water for irrigation could be supplied from multiple-purpose reservoirs in the basin or from the Columbia or Snake Rivers.

Total municipal, industrial, and rural-domestic water use is projected to increase from about 34 m.g.d. in 1970 to 76 m.g.d. in 2020. Municipal use accounts for about one-third of the total with the city of Walla Walla using the greatest amount. Only Dayton experiences shortages, and all of the municipalities except Walla Walla have water supplies readily available to meet future needs. Industrial water use is heavy with a concentration of food and pulp and paper processing plants. The pulp and paper mill at Wallula is expected to use about half of the projected industrial water by expanding its facilities on the Columbia River. Rural-domestic users are expected to continue to rely upon wells, springs, and natural streamflow.

Waters of Walla Walla River, Mill Creek, and Touchet River are of poor quality below their headwaters. Although wastes from food processing at Walla Walla cause the greatest problem, windblown soils also contribute sediment. Achieving satisfactory water quality in these streams will be difficult, but not impossible. Dilution could help but would not solve the entire problem, because more water would be required than the present runoff from these watersheds. Consequently, measures such as advanced waste treatment, selective siting of industrial plants, and irrigation with industrial waste water would have to accomplish a major part of pollution abatement.

The Walla Walla Basin will experience difficulty in stretching its water resources to meet projected demands. Additional water is needed for: (1) municipal and industrial use, (2) irrigation use, and (3) increasing summer and fall streamflows for fish and wildlife and water quality purposes.

There are several possibilities for providing additional water, including ground-water development, reservoir construction, and importation from the Snake or Columbia Rivers. Reservoir construction appears to be the most practical in light of the documented need for flood control storage, limited ground-water supplies, and expensive pumping and conveyance systems associated with importation. Also, the basin plan must respect the State of Oregon's position prohibiting out-of-state use, diversions or appropriations of water located within the state except with the consent of the legislative assembly (ORS 537.810 and resolution 2/13/64).

Two possibilities were evaluated for flood prevention along lower Mill Creek, each of which would prevent most flood damages. A 5-mile channel modification below the existing channel project was rejected in favor of storage located above the city of Walla Walla. Such storage appears preferable because of the need to provide irrigation water and to augment flows in Mill Creek and Walla Walla River for fish life and water quality purposes.

<u>1970 to 1980 Program</u> The plan includes pumping from the Columbia River and storage totaling about 125,000 acre-feet in Washington and 136,000 acre-feet in Oregon. Two major reservoirs, Dayton, which is authorized for construction, and Blue Creek, would be located in Washington on the Touchet River and Mill Creek, respectively. In Oregon, one major reservoir, Joe West, would be located on the Walla Walla River upstream from Milton-Freewater, and a small watershed project, Hudson Bay, would be located in the Pine Creek-Dry Creek area.

Irrigation water supplies, to be provided primarily by Federal reservoirs, would firm up supplies for inadequately served lands and serve a moderate amount of new land along Touchet River and in other areas of the Walla Walla Basin. A total of 49,500 and 16,000 acres of new lands would be irrigated in Washington and Oregon, respectively.

Augmentation of existing summer and fall streamflows in Touchet River, Mill Creek, and Walla Walla River would be supplied to improve fish habitat and recreation values. In addition to the fishery provided by the reservoirs, increased flows and improved water quality would enhance stream fishing for both resident and anadromous fish. Fish passage at dams on Mill Creek and Yellowhawk

Creek would complement these measures. Wildlife benefits would result from preservation of the certain areas and development of the lower Walla Walla River for waterfowl hunting. Flood plain regulation is included in the plan to prevent construction of damageable structures in the 100-year flood plain at Waitsburg. Municipal and industrial needs would be met primarily by non-Federal efforts, although Federal reservoirs in the plan would provide 6,000 acre-feet annually to Walla Walla and 1,000 acre-feet to Dayton.

Water quality would be improved through increased flows provided by storage projects. However, if satisfactory water quality is to be realized, additional measures would be required. Some of these measures are: (1) municipal waste treatment to no less than 90 percent BOD removal before release to streams, (2) industrial waste treatment to at least 90 percent BOD removal with major waste loads disposed of on land, (3) wastes from nonpoint sources, such as storm runoff from urban areas, controlled and treated, (4) future industrial expansion encouraged to locate near receiving streams which have adequate flow to assimilate treated waste loads, and (5) wastes from cattle and feedlots disposed of on land.

Long-Range Program No additional major storage projects are proposed for the 1980 to 2000 time frame; however, a small watershed project on the Walla Walla River would distribute water to 15,000 acres of new irrigated land and to 12,500 acres of inadequately irrigated land. It would also provide benefits of flood protection, erosion control, drainage, and other land treatment measures. To meet irrigation needs in the 2000 to 2020 time period, 77,000 acre-feet of storage are planned on Dry and Whetstone Creeks in Washington and 3,400 acre-feet in Vansycle Canyon in Oregon. These projects would provide a full and supplementary water supply to 8,400 acres and 3,900 acres, respectively, in Washington and 400 and 1,000 acres, respectively, in Oregon. By 2000, Touchet River at Waitsburg and the 10-mile reach of Walla Walla River downstream from Milton-Freewater would be protected by channel and levee projects. A long-range channel improvement project on Dry Creek by 2020 would complete the major flood control works.

Northside Columbia Subarea (Subregion 7)

The Northside Columbia Subarea, wholly within the State of Washington, extends eastward from the slopes of the Cascade Mountains along the north side of the Columbia River to Kennewick and consists of 4,052 square miles. Average annual runoff of

the White Salmon River at Underwood and Klickitat River at Pitt are 852,000 acre-feet, or 1,176 cfs, and 1,132,000 acre-feet, or 1,565 cfs, respectively. Ground-water resources are largely unknown except along the Columbia River and in the area surrounding Goldendale where well yields of 100 to 500 gallons per minute can be expected.

Klickitat River, Wind River, and White Salmon River have particular values to fish and recreation which warrant consideration for preservation and enhancement. Improved low flows for water quality are also needed in the Little Klickitat River, a tributary to Klickitat River. Condit Dam blocks anadromous fish use of the White Salmon River. The subarea contains a considerable amount of wildlife habitat, protection of which is important to meeting hunting and other wildlife needs.

Suitably located reservoirs could enhance recreation opportunities in the western portion of the subarea where timber and water resources combine in a favorable setting. Two streams in this area (Wind and Klickitat Rivers) could be in best use if left in a free flowing state with new impoundments located on tributaries of the main rivers.

The primary flood problems occur from floodflows in Zintel Canyon and Little Klickitat River and tributaries. Zintel Canyon, a normally dry watercourse, floods residential and industrial districts of Kennewick, Washington, and is one of two areas in Subregion 7 which were defined as needing immediate flood protection. Flooding in the Klickitat River system will need remedial action later as damages are projected to increase at a steady rate unless preventive measures are taken.

About 48,200 acres are under irrigation with the largest unit located in the Kennewick area. Irrigated land is adequately supplied primarily from surface sources. About 118,000 acre-feet of water are supplied from within Subregion 7 and 100,000 acre-feet are obtained from the Yakima Subregion to supply the presently irrigated lands. About 1 million acres of potentially irrigable lands exist in this basin. The subarea contains a portion of the extensive Yakima Indian Reservation. White Creek and the upstream portion of Klickitat River are within this reservation. A considerable amount of potentially irrigable lands is located within the reservation boundaries in both Subregion 7 and Subregion 3. Klickitat River would be a logical choice to irrigate these lands. Water resource planning must consider these potentials and the existing water rights of the Yakima Indian Reservation.

Municipal and industrial water use, exclusive of the city of Kennewick (discussed in another subregion), totals 22,500 acre-feet annually. Projections indicate that municipal and industrial

water use will total about 30,000 acre-feet by 2020, an increase of less than 50 percent. It is expected that water users can expand their present supplies to meet these demands with the possible exception of Goldendale which may require storage of up to 500 acre-feet on a nearby stream.

The only existing hydroelectric installation, Condit Dam on White Salmon River, is operated by Pacific Power and Light Company. One additional site, Ninefoot Creek, also on the White Salmon, could develop a capacity of 40,000 kw of conventional hydroelectric power. A potential combination pumped storage electric and irrigation project has been suggested at Paterson Ridge.

Even though most water treatment facilities are in need of upgrading, no critical pollution problems exist. Except for seasonal siltation problems, waters are of high quality, and conditions in the future are expected to be similar. Raw waste production is projected to increase at a rate which would be offset by improvements in waste treatment.

Ample water supplies are available to meet projected needs. Water needs for all functions except irrigation are minor, and a large share of the water supply for irrigation can be obtained from the Columbia River. Consequently, the plan for the subarea includes few major storage reservoirs.

Various development opportunities exist and primarily pertain to use of Klickitat and White Salmon Rivers. Studies to divert Klickitat River flows date back to 1904 and over the years have provided plans to irrigate land in Subregions 7 and 3. Recent plans involve diverting Klickitat River flows to Subregion 3 to irrigate lands in the Yakima Indian Reservation.

On the White Salmon River, stream preservation, hydroplant construction, and fish and recreation reservoir construction were considered. The entire river system above Condit Dam could be preserved in a free-flowing state. By retaining this area in its natural state, unaltered by instream structures and transmission lines, it would continue to be used for its present values, and the option to consider development for any purpose at a later date would be held open.

A hydroplant could be constructed on Ninefoot Creek and would generate 40,000 kilowatts of power. Enhancement of the river for fish and recreation is another possibility if Ninefoot Creek Dam would be constructed to provide a rearing reservoir for anadromous fish. Potential also exists for a resident trout fishery and settling pool for a part of the glacial flour which seasonally colors the lower river. Construction of the reservoir

in conjunction with the planned fish passage at Condit Dam would develop the potential of White Salmon River recreation and fish producing capabilities. The increased anadromous fish production which would be realized would partially satisfy the projected regional need for anadromous fish. In addition, the local economy would be enhanced by the anticipated influx of fishermen and recreationists.

1970 to 1980 Program In general, the plan proposes that Wind River be maintained free of impoundments and calls for storage development on tributary streams. Storage would be provided on the Klickitat River and diverted to Subregion 3 for use on the Yakima Indian Reservation. The plan for this basin included storage of about 100,000 acre-feet in two reservoirs on Rattlesnake Creek and West Fork of Major Creek, tributaries of the White Salmon River, and about 6,000 acre-feet on Zintel Canyon. A channel modification project would complete the flood control measures proposed for Zintel Canyon. Facilities to allow fish passage over Condit Dam are included in the plan for the 1970-1980 period. Wildlife habitat of high productivity or potential should be preserved. The flooding problem at Goldendale on the Little Klickitat River could best be dealt with by regulation of development in the flood plain followed by storage features in the period between 2000 and 2020. Since storage would not completely eliminate flooding at Goldendale, continuation of control measures would be necessary. Irrigation of 74,500 acres of land is included in the plan, with about half to be developed by private means. Municipal and industrial water supply measures and facilities for water pollution control would be accomplished primarily by non-Federal means.

Long-Range Program Hydroelectric power production would be enhanced by the construction of the Ninefoot Creek power project. The project would generate 40,000 kilowatts with waters of White Salmon River diverted from its upper reaches. No other storage projects are included in the 1980 to 2000 period. The Klickitat Division and two small watershed projects (Rock Creek and Underwood) would be developed to provide water, primarily from the Columbia River, to irrigate an additional 39,500 acres. Land treatment measures would be established to fulfill the needs. In the 2000-2020 period, storage is planned totaling 36,000 acre-feet in the eastern portion and 25,000 acre-feet in the western portion. The storage would be used primarily for fish enhancement, recreation, flood control, and a water supply for Goldendale. With expansion of the Klickitat Division and the development of five small watershed projects, an additional 107,700 acres would be irrigated. The primary source of water for the planned irrigation would be the Columbia River.

Columbia River (Subregions 7 and 10S)

The total reach of Columbia River in Area C extends from the Pacific Ocean to river mile 50 and from Bonneville Dam upstream to the mouth of the Snake River. The portion referred to as the Columbia River Estuary, which extends from the mouth about 20 miles upstream to the extent of salt water intrusion, is discussed in greater detail in the Coastal Zone and Estuaries section.

A deep-draft navigation channel is maintained from the mouth of the Columbia River upstream 106 miles to Vancouver where it is succeeded by a shallow-draft channel of 15-foot depth to Bonneville Dam. Locks at Bonneville Dam and the other dams upstream permit through navigation.

There is a need for additional waste treatment at Hood River, The Dalles, Kennewick, and other towns which have only primary treatment. Supersaturated levels of nitrogen, high water temperatures, and contamination by wastes should be prevented. The nitrogen problem, which increases with increased flow over spillways, is expected to decrease as a result of the modification of spillways and power intakes, development of new storage, and expansion of power generating capacity at existing dams.

Each of the dams on this reach of the Columbia produces electric power. In the future, these powerplants would be used more and more for peaking operations with large thermal plants picking up the baseload. Additional generators would be required at most of the existing hydroplants to more fully utilize available water for peaking purposes. Optimum peaking operations could fluctuate the water levels downstream from Bonneville Dam and in the reservoirs significantly, thereby reducing the river's environmental values and its availability for other uses.

Pleasure boating use, both by local residents and by boaters living out of the area, is expanding. Existing marinas are being expanded and new facilities are being built.

The river has geologic, historic, and unique areas, as well as high environmental values, including fish and wildlife, recreation, and esthetics. The shorelands have a wide range of use for industry, residences, recreation, and wildlife. The reach between Bonneville and McNary Dams is a fishing area for Indians established by treaties made in the 1850's.

Opportunities for development generally relate to operation of existing structures since the river in this reach is essentially fully developed from a water control point of view. Consequently, the major decision is whether the river should be

used to maximize power production or be managed for environmental purposes. Because of the complex nature of this problem, additional investigations beyond the scope of this study are required to select the plan to best fit the long-range public needs. For the purpose of this framework study, the choice of maximizing the power production potential of the river appeared warranted in view of the projected future power need.

The general plan for the reach of Columbia River which traverses Area C includes: (1) construction of additional units at existing power installations, (2) improvements for commercial and recreation navigation use in Subregion 7 and the Oregon portion of the river in Subregion 10S, and (3) provision of water supply for irrigation and municipal and industrial purposes.

1970 to 1980 Program The plan includes specific measures for the enhancement of navigation--improvement and expansion of port facilities at Astoria, excavation of shoal areas in the upper reaches of the John Day and McNary pools, and improvement of approach zones to the locks at John Day and McNary Dams. Bonneville Lock would be enlarged to increase its capacity to equal or exceed the three upriver locks, and the Union Pacific Railroad bridge over Columbia River below its confluence with the Snake would be modified. Additional port facilities and dredging of port terminal areas would be expected to be accomplished by local efforts with close coordination with environmental interests.

As the Columbia River will be used for all functional purposes, adequate treatment of all wastes to insure flows adequate in both quantity and quality must be maintained to accommodate such uses as passage for anadromous fish, resting area for waterfowl, fishing, boating, and others.

Long-Range Program in the 1980 to 2000 period, four new generators would be added to John Day Dam, increasing its capacity by 540 megawatts; and six new units would be added to McNary Dam, increasing its capacity by 420 megawatts. The capacity of the Bonneville powerplant would be increased by 480 megawatts.

In order to meet the projected power demand within the region, a considerable amount of power must be generated by thermal means. A substantial portion of this generation could be produced in the Mid Columbia area. The most favorable location of these plants would be along the Columbia where adequate water for cooling purposes is available. Because once-through cooling with Columbia River water would increase the temperature of the river, some other

means for dissipation of heat, such as cooling ponds and towers, should be used. In total, 15,000 megawatts of thermal electric capacity would be installed by 2000, followed by another 25,000 megawatts between 2000 and 2020.

Willamette Subarea (Subregion 9)

The Willamette Subregion, with an area of 12,045 square miles, lies in northwestern Oregon between the Cascade and Coast Ranges. With a 1965 population of 1.34 million, the subregion accounted for 68 percent of the population of the State of Oregon. It is composed of the drainages of the Willamette and Sandy Rivers and, due to relatively heavy precipitation, has an average annual runoff of over 27 million acre-feet. It also contains considerable ground water, which ranges from meager in parts of the Coast Range to copious in parts of the valley floor and the Cascade Range.

The Willamette River is the largest Columbia River tributary below the dams and as such has a tremendous potential for increasing supplies of anadromous fish, particularly of fall chinook and coho salmon. The major needs are the completion of screening at the Willamette Falls Fishway, controlling pollution in the Willamette River system to safe levels, installation of passage facilities at barriers, and smoothing out extremes of streamflow by releases from storage. Although the cool waters support a considerable number of trout, natural reproduction of trout is not expected to increase beyond present levels. Measures needed to improve trout fishing include improved angler access, new fishing impoundments, and expansion of hatchery facilities. Natural reproduction of warm water game fish is expected to equal demands if improved access is provided.

A variety of wildlife exists, but future hunting demands are expected to exceed the subregion's capabilities. The primary needs are for improved hunter access and the preservation and enhancement of the habitat.

The subregion is richly endowed with natural resources that provide a variety of recreational opportunities and a quality environment. To meet future recreation needs, additional facilities will be required and additional water surface is needed in the lower part. Also, a number of streams and reaches of streams should be retained free of impoundments and available for recreation use. The Willamette River Parks System program will contribute materially to meeting future needs.

Although much progress has been made in the last 30 years in alleviating flood problems, continuing development in the flood

plain has expanded the potential for flood damages. To solve the flooding problem, a continuing program is needed which will blend nonstructural measures with reservoir, channel, and levee construction.

Projections of irrigation needs are based on the assumption that the subregion will meet its proportionate share of the Nation's food and fiber need. Projected irrigation needs are for 756,000 acres to be added by 2020 to the presently irrigated 244,000 acres.

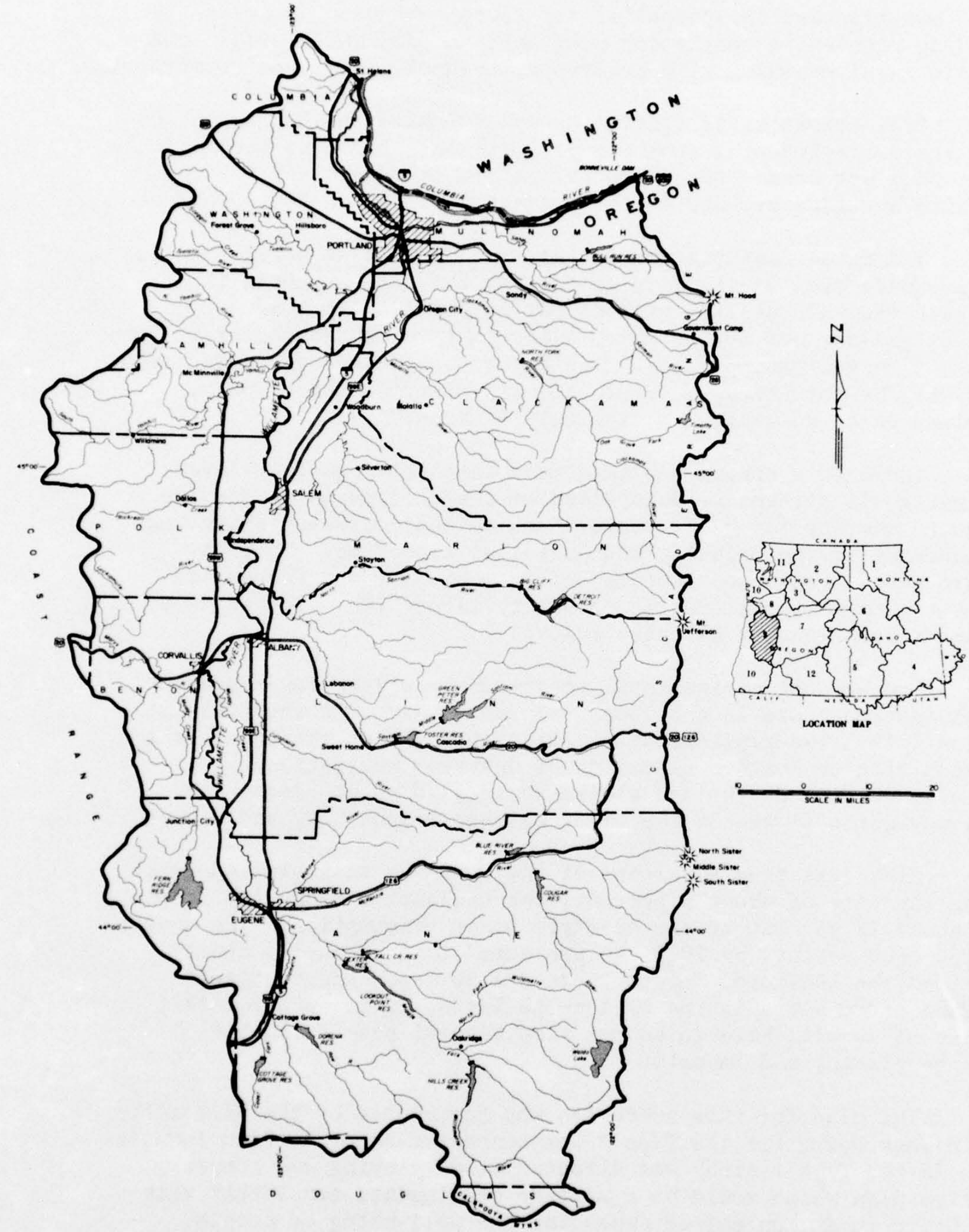
The total domestic, municipal, and industrial water supplies are adequate even in the face of demands that are expected to increase from 370 million gallons per day in 1965 to 1,440 million gallons per day in 2020, although local shortages exist in areas of meager ground water. The major problem and the associated need will be for storage, treatment, and distribution of water supplies so as to make them available as needed.

There is a strong public demand that water quality levels in nearly all streams be maintained or restored so as to provide adequate quality for water contact sports and for maintenance and enhancement of the existing and potential fisheries. To meet future needs, continued improvement in municipal and industrial waste treatment facilities is necessary along with maintenance of summer streamflows at acceptable levels.

The present navigational improvements will allow expansion of navigational use in the lower Willamette River to the falls at Oregon City. The replacement of existing locks at the falls is a prerequisite to further expansion of upstream navigation. Improved channel depths and widths would also be necessary for full navigational use of the river between Oregon City and Eugene.

With less than 5 percent of the area and an installed generating capacity of about 5 percent, the Willamette Subregion accounts for about 25 percent of the electric power consumption. The annual energy requirements by 2020 are projected to increase to about 34 times the 1965 use. Since there are no major undeveloped hydroelectric sites in the Willamette Basin, it is apparent that future needs will have to be met from thermal plants, pumped storage plants, and imports.

The plan for this subregion was formulated by the Willamette Basin Task Force for the Type 2 Comprehensive Report. Plan formulation in the Type 2 study was directed at developing one comprehensive plan which would be a mixture of elements consistent with the basic study concept of enhancing the well-being of people. In that context, consideration was given to all available alternatives, including that of no development. With respect to overall functional needs, doing nothing was dismissed as totally inappropriate in view of the expected large demands for water and the wide range of opportunities.



COLUMBIA–NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

WILLAMETTE SUBAREA

WILLAMETTE SUBREGION 9

FIGURE 18

A basic finding was that multiple-purpose storage projects would be needed to control and conserve water. There are two principal alternatives to storage development as a means of providing additional water for downstream use. These alternatives consist of development and use of ground-water resources and watershed management programs to increase low water flows. In general, the ground-water alternative was considered adaptable only to relatively limited irrigation and domestic-municipal water supply needs. Although watershed management programs would be capable of improving water quality, enhancing reservoir filling potential, and reducing siltation, they would be incapable of meeting any significant part of total downstream needs for increased flow.

Regulation of flood plain use to limit increase in flood damage potential would be an alternative to any potential single-purpose development for flood control. However, it was considered as a supplement rather than an alternative to the flood control function of multiple-purpose storage. The primary reason for that decision was that substantially all flood control effects of multiple-purpose storage could be achieved by joint use of space required for other purposes.

1970 to 1980 Program The plan includes almost 933,000 acre-feet of storage in 38 new reservoirs and enlargement of one existing reservoir. Flood control by these and existing reservoirs would be augmented by channel modification on 47 miles of Willamette River and reservoir-controlled tributaries to facilitate reservoir evacuation, and 4.6 miles of bank stabilization work would be done at 14 locations on other tributaries. On minor tributaries, channel work would be accomplished by 17 small watershed projects. Irrigation would be provided for 186,000 additional acres, about 142,000 acres of which would be by Federal and federally assisted projects.

Programs included in the comprehensive plan cover a variety of subjects. The existing fish hatchery program would be supplemented by an extensive program for expansion and replacement of outdated hatchery facilities. This would provide anadromous and resident fish for pond and reservoir rearing programs and trout for sport fishing in reservoirs and streams. A complementary program is for state acquisition of 350 access sites to streams flowing through private lands. Also included is access to a number of oxbow lakes, borrow pits, and low elevation impoundments. For wildlife purposes, a two-part program of research and education and increasing wildlife populations and hunter access is included. Specifically, it would include securing certain unused or undeveloped flood plain lands with high potential for producing wildlife, leasing and developing about 23 pigeon springs, acquiring three tracts on the valley floor for additional waterfowl refuges and

nesting and feeding areas; contracting with landowners for access to farm and forest lands; and either adopting a management plan to maintain constant levels of Fern Ridge Reservoir from May 1 to July 1 to enhance waterfowl nesting or developing a system of dikes for the same purpose. The plan includes programs for reducing flood damages through flood forecasting, small project construction, emergency action, and local flood plain zoning or land use regulation. Additionally, the plan provides for reauthorization of existing reservoir projects, where appropriate, to include such new functions as fish and wildlife enhancement, municipal and industrial water supply, recreation, and water quality control.

Land measures programs by small groups of landowners would be applied at 133 locations in the basin. They would provide for approximately 30,000 acres of drainage improvements and a combination of 108 miles of streambank and channel stabilization, shaping, clearing, and dike construction. Accelerated land treatment programs would be carried out in 26 small watersheds. Specific recommendations for forest lands include 130 miles of gully stabilization, 5,700 acres of sheet erosion control, 202,000 acres of cropland drainage, 251,000 acres of land treatment, 21 miles of channel debris removal, 56 miles of channel revetment, and 220 miles of road and trail restoration. In addition to the accelerated land treatment associated with projects activities, the ongoing programs would account for a proportionately larger amount of erosion and sediment control, cropland drainage, water conservation, and land treatment.

Several programs are included in the plan for navigation and recreation. The plan includes continuation at the present level of a program for Federal clearing and snagging to improve navigation. Also included is suggested governmental responsibilities for recreation facilities to provide for more than 10 million recreation days of use. This will require full use of the capabilities of the private sector and of local, county, State, and Federal groups and agencies. The plan calls for a coordinating committee to be established to coordinate all of those aspects of recreation programs and activities which involve both governmental entities and the public.

The basic element of the water pollution control program is a high level of at-source waste treatment by all municipalities and industries. Other elements of the overall plan include: (1) flow augmentation to the extent justifiable as a supplement to high levels of waste treatment; (2) completion of interceptor sewer facilities in the Portland metropolitan area; (3) control of wastes from houseboats and other water craft, including large ships; (4) control of fertilizers and commercial toxicants; (5) soil stabilization; (6) control of animal waste discharge to water bodies; (7) control of urban storm runoff; and (8) other management practices.

A program of management for preservation and protection of selected streams, stream reaches, and adjoining lands is an important part of the plan. The proposed environmental management program would provide for protection of flows, water quality, and natural streamside environment. It covers all but excepted portions of 29 specifically named streams, plus all streams in five wildernesses and three designated forest recreation areas. On those named streams it covers more than 1,250 miles of natural channel and the immediately adjoining lands.

Long-Range Program During the 1980 to 2000 period, 32 new reservoirs in the plan total about 1,282,000 acre-feet of storage capacity. About 40 additional miles of channel modification would be provided to facilitate operation of reservoirs for flood control. In addition, two channel projects involving 63 miles on Tualatin River and 46 miles on Pudding River would be completed. Channel modification would also be accomplished on selected small tributary streams. The plan includes irrigation facilities to serve 420,000 acres of new lands. Navigation elements consist of the authorized reconstruction of Willamette Falls Locks and open-channel works which, as a supplement to increased low water flows, would provide increased depths for navigation in Willamette River upstream to the Corvallis-Albany area. Electric power production would be increased by the installation of 39.5 megawatts of capacity at the existing Cougar project (includes Strube reregulating dam) and the construction of the Shellrock project with a capacity of 35 megawatts. Also included are thermal powerplants to generate 5 million kilowatts of electric power. Programs initiated during the previous period would be continued as required. Twenty-three small watershed projects would be designed and constructed to provide storage, 27,000 acres of flood protection, 87,000 acres of cropland drainage, water conservation measures to 143,000 acres, and 87,000 acres of land treatment. Land and water measures would be continued on nonproject land through individual effort.

During the 2000 to 2020 period, the plan includes 24 new reservoirs with an aggregate storage capacity of about 701,000 acre-feet. An additional 20 miles of channel modification for reservoir evacuation purposes would be accomplished. In addition, a channel project involving 55 miles of Yamhill River would be completed. Channel modifications would also be accomplished on selected small tributary streams. The plan includes irrigation facilities to serve 150,000 acres of new lands. Twenty-three small watershed projects would be developed to install a combination of land and water conservation practices. Thermal electric plants to generate 19,000 megawatts are included in the plan. Programs initiated in the first time period would be continued as needed.

Rogue River Subarea (Subregion 10S)

The Rogue Basin is a ruggedly beautiful area located in the southwestern corner of the State of Oregon. Its 5,000 square miles are covered on the foothills and mountain slopes by conifer forests while its valleys, occupying by far the lesser of the area, are farmed.

The salmon and steelhead fisheries of the Rogue River are nationally famous, and significant steps have been taken to preserve, restore, and enhance this resource. The state has filed on increased flows to be provided by authorized Federal multiple-purpose projects, one of which now is under construction in upper Rogue River Basin. Also, the lower 85 miles of the Rogue River are included in both the National Wild and Scenic Rivers System and the State Scenic Waterways System. The lower 46 miles of the Illinois River are included in the State Scenic Waterways System, and the entire river is being studied for possible inclusion in the national system.

To meet future recreation and fish and wildlife needs, preservation should be considered for another reach of the Rogue River from Lost Creek damsite to Applegate River and for the remaining portion of Illinois River from Deer Creek upstream. Once the basic stream system is safeguarded, fish numbers can be increased through improved fish passage facilities at the nine existing dams, provision of gabions and sills to increase the pool riffle ratio, mechanical removal of silt from stream channels, improved streamflows, artificial propagation, and a variety of other management programs. Another need is for several small reservoirs in the upper tributaries to be operated only for recreation and fishing.

Future hunting pressures can be met only through an extensive program of habitat preservation and improvement. Maintenance of abundant big game herds will depend upon protection of the critical winter ranges up to 2,000 feet elevation in the Coast Range and up to 3,000 feet elevation in the Cascade Range. Waterfowl and some other birds and mammals depend upon wetland and water areas. Consequently, the most significant should be studied for possible preservation. Flood plains generally provide excellent wildlife habitat; therefore, management programs recognizing wildlife uses are needed to protect them from encroachment by industries, highways, and urban areas which have little or no need for location in these areas. These areas should be preserved so increased production can be accomplished by habitat improvement measures such as cover manipulation, fencing, and the construction of waterholes.

Flooding problems along the main stem of the Rogue River are confined generally to a 75-mile reach that extends downstream from the Lost Creek damsite. Above and below that reach the river flows through deep canyons in mountainous terrain and causes little damage except for a very short reach immediately upstream from the river mouth near Gold Beach. Damages also occur along the tributary streams of Big Butte Creek, Little Butte Creek, Bear Creek, Evans Creek, Applegate River, Grave Creek, and the upper part of the Illinois River. The projected damages can be reduced significantly by construction of storage reservoirs and levees and by development of a sound flood plain management program. Authorized reservoirs will provide 280,000 acre-feet of flood control storage out of a total need of 1.25 million acre-feet for complete control of flooding.

About 22,000 acres of cropland have erosion problems. Both sheet and rill erosion occurs on disturbed range soils in the Grants Pass and Bear Creek area. Shifts in cropland and range areas from better soils to more erosive soils are expected to increase the erosion problems in the future. Almost 26,000 acres of cropland need drainage, about half of which are in the Bear Creek Valley near Medford. Because of topography and stratigraphy, drainage of this area should be accomplished as a unit. Most of the remaining areas can be drained by individual landowners with some community outlets installed by small groups. Drainage problems in Bear Creek Valley are expected to compound with the addition of irrigation water. Identified projects could satisfy the majority of these and other land treatment needs; however, other agency programs and private development would be necessary to meet the remaining needs.

Population expansion is expected to occur in the Medford service area which includes the cities of Medford, Ashland, and Jacksonville. The largest municipality, Medford, obtains its water from Big Butte Springs with additional water rights for Rogue River flows and plans to make future use of water to be stored in Lost Creek and Elk Creek Reservoirs. Thus, it is assured of a reasonably adequate supply in the future. Grants Pass, however, is in need of additional supplies and soon will have to make use of stored water from the same storage sources. Other municipalities, self-supplied industries, and rural-domestic users generally can expand their present supplies to meet future needs.

Considerable irrigation potential exists within the subarea; nearly 39,000 acres of the presently irrigated lands are short of water, being in need of an additional 33,000 acre-feet of water annually to reach full production. In addition, about 329,000 acres of additional land are suitable for irrigation. For the most part, however, development of any of this land generally will be dependent upon group projects utilizing storage of streamflow.

The only identified remaining potential for conventional hydroelectric power production is the Lost Creek site on the Rogue River of 49 megawatts. In addition, eight potential pumped storage sites have been identified with individual capacities of 1 million kilowatts or more. If future studies indicate that development of a portion of these is necessary to meet peaking requirements, environmental impact studies should be initiated to facilitate selection. It is anticipated that requirements for base power generation will be satisfied by importation from other areas where large thermal electric plants are to be located.

Water quality in basin streams is generally adequate with the exception of Bear Creek and the Rogue River below Bear Creek. In addition, many of the smaller tributaries are virtually dry in late summer. Bear Creek through and below Medford becomes an esthetic nuisance during summer months. Nutrients promote extensive aquatic growths, and bacterial densities are high. A minimum flow of 75 cfs is needed for water quality control. The entire length of Rogue River below Bear Creek exhibits coliform bacterial densities greater than desirable for safe water-contact recreation. Maximum temperatures in this reach often exceed 70°F. from June through September, and in the canyon reach below Grants Pass temperatures occasionally exceed 80°F. Improved waste treatment facilities completed recently in the Medford area will reduce coliform densities in the Rogue River to safe levels; but, if temperatures are to be lowered to acceptable levels for fish life, a minimum flow of 2,000 cfs would have to be provided from storage during summer months.

Navigation is possible only for a short reach of the Rogue River near the mouth. Navigation needs for this area are included in the discussion for the coastal basin.

Although several major opportunities exist for meeting needs in the Rogue River Basin, a primary decision is whether to build a dam on Applegate River, one of the streams selected in the Recreation Appendix to be studied for possible preservation as a free-flowing stream. The dam is authorized for Federal construction and is included in the plan because it would be located high in the watershed, thereby retaining the major portion of the stream in a free-flowing state. It would also provide flood control, increase summer streamflow downstream, and permit reestablishment of spring chinook salmon runs in Applegate River.

Other identified potential projects could meet possible local objectives beyond projected future needs. Four of the small watershed projects are in the upper Illinois River drainage (Deer Creek, Sucker Creek, Althouse Creek, and West Fork Illinois River), and the other is in the Williams Creek area of the Applegate River drainage. These five projects would involve at least eight reservoirs

storing about 144,500 acre-feet of water, having about 2,360 acres of surface area, and providing a supplemental irrigation supply for 8,900 acres and a full supply for 33,700 acres. Flood control, drainage, erosion control, and recreation benefits would also accompany the projects.

An alternative to the small watershed project on Sucker Creek is a larger multiple-purpose project involving a 40,000 acre-foot reservoir, a small diversion dam, and an irrigation distribution system. The project would enable irrigation of 11,000 acres of new lands as well as providing 470 acres of surface area, downstream flood control, and increased summer flows in Sucker Creek and Illinois River.

1970 to 1980 Program In this period, 738,000 acre-feet of storage would constitute the nucleus of the water plan. The authorized dams--Lost Creek Dam on the Rogue River, Elk Creek Dam on Elk Creek, Applegate Dam on Applegate River, and Sexton Dam on Jumpoff Joe Creek--would impound most of the water with the remainder being stored on Evans Creek and Little Butte Creek. About 33,000 acres of land would be irrigated by these reservoirs and another 8,600 acres, primarily in the Medford area, would be provided a supplemental supply. The storage would also be effective in providing 49 megawatts of electric power and future water supplies for the municipalities of Grants Pass, Gold Hill, and Rogue River. Also, flow augmentation in Bear Creek, Applegate River, Evans Creek, Rogue River, and Little Butte Creek would improve temperatures and other quality parameters for fish and recreation.

Flooding would be reduced in several areas, including along the Rogue River from Lost Creek Dam to the vicinity of Grants Pass. The Little Butte Creek small watershed project would provide flood protection on more than 800 acres of the flood plain. The Grants Pass area would be further protected by development and implementation of a flood plain management plan. Studies of preservation of the remaining reach of Illinois River and an additional reach of the Rogue River (Lost Creek damsite to Applegate River), in addition to protection and improvement of identified key wildlife habitat, are included in the 1970 and 1980 program. Also, fish passage facilities would be installed at existing obstructions where justified as needed to allow access to former spawning areas.

Continued agency programs and private development would meet remaining projected needs in the fields of land treatment, irrigation, municipal and industrial water supply, water quality, recreation, fish and wildlife, and some of flood control needs. A review of water rights should be made to determine those no longer in use.

Long-Range Program No major structural measures are proposed in the 1980-2000 period. Needs for this period generally are smaller than for the other periods and, with the exception of two projects, would be met by private initiative, agency programs, and carry-over capacity included in storage projects for the previous time frame. The Bear Creek project with 3,200 acre-feet of storage, included in the plan for this time period, would provide recreation opportunity, a water supply for the community of Talent, and drainage of 14,500 acres of cropland, mostly pear orchards. A 5-mile levee construction project would expand flood protection in the Grants Pass area.

The program during the 2000 to 2020 period includes measures of a program nature. The planned irrigation in this time period, 6,590 acres of new lands and supplemental supplies to 1,200 acres, would be accomplished primarily by the Applegate project utilizing storage from Applegate Reservoir, an element of the 1970 to 1980 program. Other plan measures include such items as land treatment, recreation facility development, waste treatment, and other fish and wildlife facilities.

Umpqua River Subarea (Subregion 10S)

The Umpqua River Subarea is located north of the Rogue River Basin in southwestern Oregon. The Umpqua River drains the entire basin and discharges directly into the Pacific Ocean near the city of Reedsport.

One of the major problems is flooding. Damaging floods are almost an annual occurrence, with damages occurring on agricultural lands in the central valley portion of the basin. Urban areas adjacent to Roseburg, Winston, and Myrtle Creek, and portions of Drain, Sutherlin, and Canyonville are inundated. Good protection on the Umpqua and South Umpqua Rivers could be achieved with about 300,000 acre-feet of upstream storage. The Days Creek Reservoir on the South Umpqua River, Galesville Reservoir on Cow Creek, and Olalla Reservoir on Olalla Creek could provide a total of about 417,000 acre-feet of flood storage. Additional flood reduction could be provided by 26,000 acre-feet of storage on Calapooya Creek. As an alternative, flood protection could be provided with 24 miles of levees along the Umpqua River and tributaries and flood plain regulation in the areas around Reedsport and Roseburg. Coordination and scheduling of levee construction with upstream storage projects would be necessary.

Federal agencies have studied irrigation development, including major project development of 42,800 acres. Investigations have been made on a 14,500-acre project to be irrigated from storage on Olalla Creek, a 16,000-acre project near Sutherlin to be irrigated from storage on Calapooya Creek, and a 12,300-acre

project along the South Umpqua River to be supplied by storage on the South Umpqua River or tributaries. In addition, four small watershed projects with a potential for developing about 30,000 acres of land are being considered for Calapooya Creek, Elk Creek, Myrtle Creek, and Deer Creek.

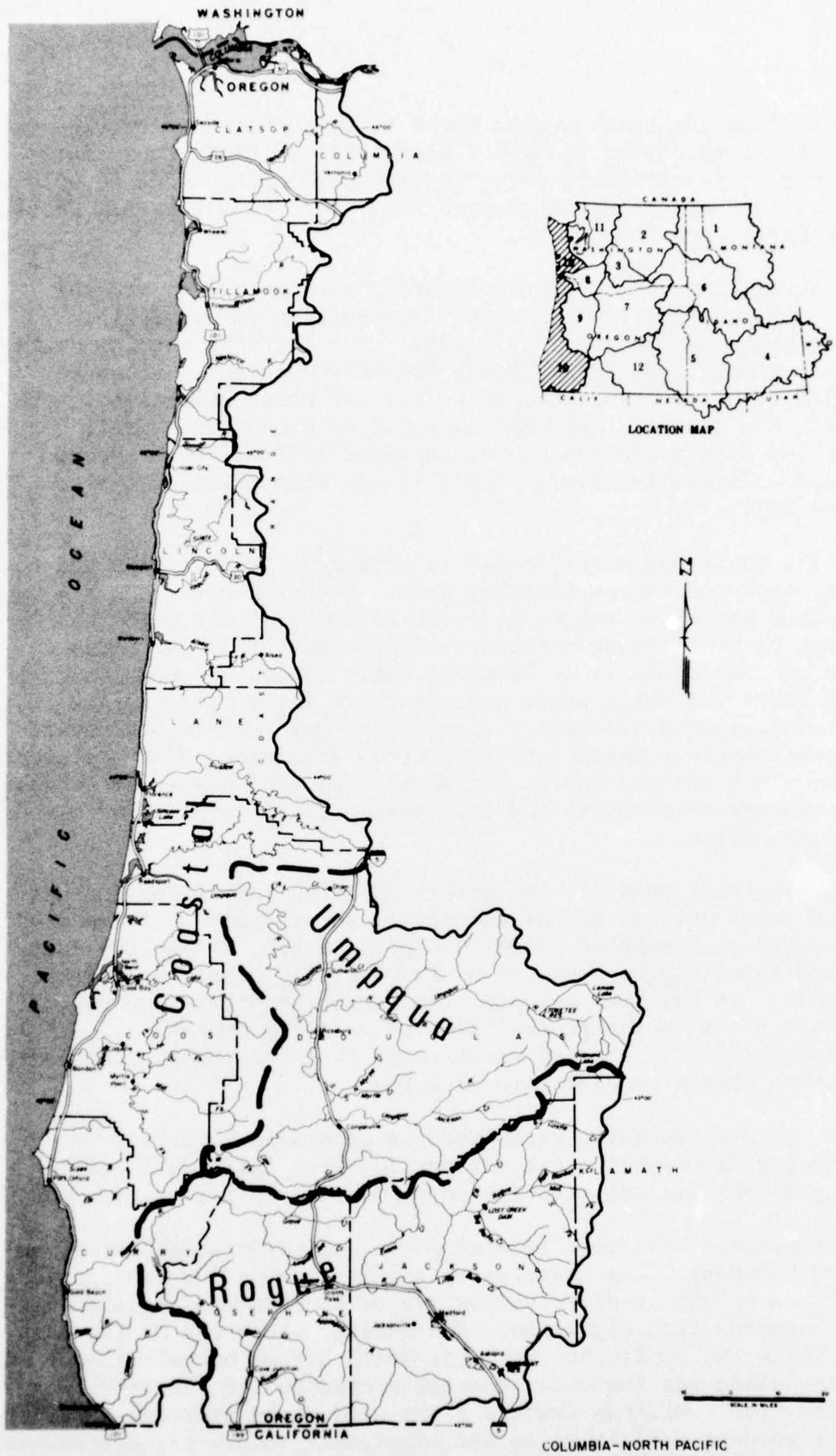
Navigation on the Umpqua River is not extensive; however, some tug-barge traffic does exist in addition to commercial fishing boats and recreational craft. The existing shallow draft navigation entrances and channels are only marginally adequate. To fulfill the need for year-round tug and barge operations, both entrance and channel improvements would be necessary. Small boat facilities also would need to be expanded and improved. Needed navigation facilities are included in the discussion of the Coastal Basin.

The municipal water demand is presently, and is expected to remain, centered in the Roseburg area. The city obtains its water from the North Umpqua River where supplies are more than adequate to meet future demands. Other communities and homes in the general vicinity of Roseburg which depend on creeks and ground water for their water supplies have inadequate supplies. The Reedsport area also has a significant water demand; however, no future supply problems are expected. Basinwide, adequate quantities of water are available, but some local problems exist because of low summer streamflows and inadequate water rights to accommodate future expansion.

The forest products and nickel smelting industries account for the major portion of the industrial water demand. These needs are located at Reedsport, along Calapooya Creek, and in the Roseburg and South Umpqua area. A nickel smelting plant is located at Riddle. It has been assumed that future industrial growth will take place in the general area of existing operations. Some industries are located where water supplies are insufficient, and future supply problems are expected.

The rural-domestic water need is generally satisfied by withdrawing from small creeks or pumping from individual wells. Major problems are not anticipated in meeting future water needs.

Presently, the most serious water quality problem exists on the South Umpqua River where water quality during low flow periods does not meet either dissolved oxygen or temperature requirements for anadromous fish migration. The quality is better in the main river below the confluence with the North Umpqua but still does not meet the standards for water-contact recreation or the needs for salmonid fish. Minimum average flows need to be provided immediately, since treatment facilities do not completely remove all contaminants from waste waters before discharge. Furthermore, to insure good



COLUMBIA-NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

PLAN FORMULATION SUBAREAS

COASTAL SUBREGION 10S

FIGURE 19

water quality, a coordinated program of waste reduction, flow regulation, application of waste control techniques, and development of a system of cooperative management of the water resources will be required. Organic waste treatment reduction of 85 percent by 1980 and 90 percent for 2000 and 2020 will be necessary. Other pollution control measures include prohibiting the discharge of waste from boats and ships in the estuary, sewage disposal systems at all recreation areas, more efficient dredging practices to minimize turbidities and reduce the toxic oxygen demanding materials, and timber harvesting techniques that would minimize changes in the area's hydrologic character.

The Umpqua Basin has a variety of outstanding opportunities for fishing, hunting, camping, and picnicking, ranging from coastal zone and estuaries to mountain lakes and streams, to forests and alpine meadows. Opportunities for future water-related recreation activities would be developed at the proposed storage reservoirs. Streams recommended to be left in their current state for recreation purposes are the main stem Umpqua River from its junction with the North Umpqua and South Umpqua Rivers to tidewater, a total of 87 miles, and the North Umpqua River from Lemolo Dam to its confluence with the Umpqua River, a total of 83 miles.

A variety of fish and wildlife are of major economic and recreational importance. Commercial fishing boats operate out of Winchester Bay harvesting marine, anadromous, and shellfish. Sport fishing opportunities also exist on the Umpqua River and many of its tributaries. Abundant deer and upland game hunting opportunities exist. Future fish and wildlife needs can best be met through careful planning of urban and industrial development to minimize pollution and to preserve key fish and wildlife habitat. Fish habitat improvement could be accomplished by providing passage at numerous manmade and natural barriers. Improved water quality in the Umpqua tidal area, Deer Creek, Cow Creek, and Elk Creek would benefit the fish resource. Low flows need to be augmented in Cow Creek, on the South Umpqua River downstream from Cow Creek, Elk Creek, Olalla Creek, and the Umpqua River. Estuarine, wetland, and other water areas used extensively by waterfowl should be protected. Other wildlife habitat improvements needed include more fencing, habitat management, acquisition of land, and development of new waterholes.

It is unlikely that there will be any new hydroelectric development in the Umpqua Basin. There are a number of potential pumped storage and thermal nuclear powerplant sites with several of the latter presently being studied.

Major efforts will be necessary to maintain the high quality of environment, scenic roads and trails should be expanded, and, as previously discussed, several streams should be left in their

free-flowing state. Widespread zoning is needed to assure that commercial and private developments, both industrial and recreational, are harmonious with the surroundings and of proper densities. This is especially important in the lower reach of the Umpqua River and in the Winchester Bay area. Existing primitive, historical, and archeological values should also be preserved.

The primary decision for this basin is whether or not to include major storage facilities on Umpqua River and its major tributaries. In this regard, storage on North Umpqua River or the main stem of Umpqua River does not appear necessary to meet needs nor is it environmentally desirable. Storage on the South Umpqua River, however, appears highly desirable and is reflected in the recommended plan. Two small watershed projects on Elk and Deer Creeks are alternatives to portions of the irrigation recommended for the Rosealea project and were rejected because they conflict with what appear to be the more environmentally acceptable and economically justifiable projects selected for the framework plan. Elk Creek is tributary to the Umpqua River in the vicinity of Elkton. Storage on Elk Creek could supply about 53,000 acre-feet of water which could be utilized for irrigation of about 15,000 acres of land. Flood prevention, drainage, erosion control, and municipal and industrial benefits would also accompany the project. Deer Creek is tributary to the South Umpqua River in the vicinity of Roseburg. A reservoir could be constructed on Deer Creek to store over 14,000 acre-feet to be used to irrigate over 4,000 acres. Flood prevention, drainage, and erosion control would also be included in the project.

1970 to 1980 Program The program for the 1970 to 1980 period includes a small amount of private development and two storage projects--Olalla Division and Calapooya Creek. The Olalla Division would include a reservoir with a capacity of 73,000 acre-feet of which 37,000 acre-feet would be used jointly for flood control and conservation purposes. The reservoir would also provide the basis for development of recreation facilities, supply water to irrigate 14,450 acres, and furnish water for municipal and industrial purposes. Also, in conjunction with the Olalla development would be the enlargement of an existing fish hatchery, flow augmentation in Olalla and Lookingglass Creeks, and rearing of anadromous fish in Olalla reservoir.

The Calapooya Creek project reservoirs could provide nearly 30,000 acre-feet of storage. In addition to providing irrigation supplies for 7,500 acres of new land and 1,100 acres of inadequately irrigated land, the project would also supply water for municipal, industrial, and domestic use and flood prevention, drainage, and erosion control benefits. Flood plain management studies are recommended for the Roseburg and Reedsport areas along the South Umpqua and Umpqua Rivers, respectively.

Municipal and industrial water supplies would be expanded to meet the needs for this period. In most areas this does not present any major problems; however, in some cases additional water rights must be obtained. Domestic water needs would continue to be met by natural streamflow and ground-water withdrawal. Waste treatment must reach the 85 percent level by this time period. Minimum flows would be established on Cow Creek, South Umpqua River, and the lower reaches of the main stem Umpqua River. Dredging and logging techniques would be modified to minimize pollution problems.

Recreation needs in the Umpqua Basin for this time period would be met by expanding existing camping and picnicking facilities and constructing additional facilities at the proposed reservoirs. Streams recommended for study for preservation in their free flowing state include the entire North Umpqua River, the entire main stem Umpqua, and the main stem Smith River.

Long-Range Program The proposed program for the 1980-2000 time period includes the Days Creek and Galesville projects. In addition, new irrigated land would be developed through private efforts, using natural streamflows and small ponds. The Days Creek reservoir would have an active capacity of about 405,000 acre-feet of which 205,000 acre-feet would be available for flood control. The reservoirs would also provide water for irrigation, recreation, municipal, and industrial use. A fish hatchery would also be constructed in conjunction with the reservoir, and some streamflow augmentation also would be possible.

The Galesville project includes a 75,000 acre-foot reservoir. Flood flow storage for 35,000 acre-feet would be available, and water would also be available for irrigation and flow augmentation. A fish hatchery and passage facilities also would accompany the reservoir development.

Land measures and watershed protection programs and flood plain management programs will be necessary during this time period. Reduction of flood damages would result from construction of 24 miles of levees on the Umpqua River and tributaries. Navigation development would be limited to maintaining channel and jetty developments constructed in the 1970 to 1980 period.

Two more projects, Rosealea and Myrtle Creek, are included in the 2000 to 2020 time period. The Rosealea project would distribute full or supplemental irrigation supplies from Days Creek or Galesville reservoirs to 6,900 acres of land. The Myrtle Creek project reservoir would have a capacity of 7,000 acre-feet and would be used primarily for irrigation supplies on approximately 2,800 acres. Associated with irrigation development would be

drainage, flood prevention, and erosion benefits. The reservoir would also provide the basis for nearly 2,000 additional recreation days use.

Coastal Subarea (Subregion 10S)

The Coastal Subarea includes the approximately 500 miles of Oregon coast extending inland to the crest of the Coast Range and including the lower Columbia River estuary. Water resources are abundant with an average annual runoff of about 26 million acre-feet. The favorable characteristics of soil and climate combine to make the basin one of the world's most significant timber production areas.

Over-bank flooding occurs on most of the coastal streams at least once every year. Most of the development on land so flooded is compatible with the frequent short-term inundation and therefore little erosion damage results, although reduced production, streambank erosion, and estuarine sedimentation are serious problems. Little potential exists for developing effective flood control storage, as most of the streams flow in steep narrow valleys without suitable reservoir sites in the upstream reaches. Further, most flood damages occur along the tidal reaches where upstream storage has little effect on water levels. At potential sites, joint use of storage for conservation uses is limited. Because flooding may occur as late as the last of April, storage space would have to be maintained so late in the spring that in many years filling would not occur and thus there would be a shortage of water for conservation purposes. Levees and flood walls could provide protection in the tidal zone areas subject to flooding. Flood plain regulation appears to be the best choice to prevent increased flood damages on much of the frequently inundated land.

Development of irrigated lands has been accomplished by private enterprise. The 32,200 irrigated acres are scattered throughout the cropland, but concentrations do occur in the Tillamook area and in the Nehalem and Coquille drainages. Potentially irrigable lands are found in most of the river valleys, and although those lands total about 252,000 acres, much of it is in narrow discontinuous tracts unsuited for large project development. As known ground-water supplies in quantities suited to irrigation requirements are available in only a few areas, surface water supply is assumed for most future irrigation developments.

Navigation at all ports is hindered to varying degrees by lack of depth in channels. In addition, navigation is delayed at the entrances to all ports during periods of poor visibility and when waves make the entrances too rough for safe transit. Deeper channels are needed in Coos Bay and Yaquina Bay to meet

the requirements of deep draft shipping. Entrance and channel improvements in Siuslaw, Rogue, Chetco, Tillamook, Coquille, and Umpqua Rivers are needed to meet the requirements of shallow draft barge navigation. Terminal facilities at these locations need expansion and modernization. Improvements of channel and entrance conditions to serve other commercial navigation also will satisfy most of the navigation needs of the commercial fishing vessels.

A need exists for expansion and improvement of recreational boating facilities. Existing facilities at ports possessing relatively safe access to the ocean are overcrowded during the peak of the recreational season. Consequently, some boaters use harbors with entrances that are unsafe except during the most favorable sea and weather conditions. There is a need for three additional boat harbors along the Oregon coast in addition to expansion of facilities at existing sites.

Most of the municipal and industrial water is supplied by surface sources. Rural-domestic needs are satisfied by pumping from individual wells and withdrawals from small creeks. Streamflows are adequate to supply the needs for municipal and industrial uses in all but the low flow summer months. Small reservoirs to store the excess winter flows and operate during the summer months to augment the natural streamflows can assure adequate water supply on a yearly basis.

Quality of water is generally good although dune sources are high in iron. The discharge of inadequately treated municipal and industrial waste into the coastal streams also creates serious water quality problems during the late summer months. This late summer period corresponds to the time of lowest yearly inflow and maximum consumptive water use. Waste production and water demand for agricultural, industrial, and municipal uses are expected to increase with economic and population growth of the area. To insure adequate water quality, a coordinated program of waste reduction and waste management will be required. Complete waste collection and treatment will be the primary means of maintaining satisfactory water quality.

Recreational areas in the Coastal Subarea range from the many miles of sandy beaches and scenic headlands to the vast acreages of semiwilderness forested uplands. Increasing population, affluence, and leisure time are expected to greatly increase demands on recreational areas and facilities. In addition to the nationally famous salmon and steelhead sports fisheries, other recreational activities include sightseeing, picnicking, camping, and boating. Development of the water and related land resources to fully realize the recreational potential of the area is imperative. Such development should consist of additional recreation facilities and a program to maintain or enhance the land, stream, and estuarine areas which comprise the generally high quality environment.

Fish and wildlife habitat have been adversely affected by urban and industrial development. Developments have removed bank vegetation, channelized streambeds, removed gravel and bottom materials in spawning channels, introduced domestic and industrial waste in destructive concentrations, and dredged and filled shellfish areas of the tidal zones. To meet the hunting and fishing needs and to insure that the fish and wildlife are not drastically reduced in number and threatened with extinction, an extensive program of habitat improvement and preservation and expansion of artificial propagation of some species will be required. Development of water storage in upper watershed areas to increase low water flows and improve water quality is desirable. A management program for streams and adjacent land to prevent encroachment of industrial, urban, and other noncompatible development is essential to improvement of the fish and wildlife habitat. The Columbia River estuary, because of its regional importance as the anadromous fish gateway to the entire Columbia-Willamette-Snake Rivers system, must be provided adequate protection if it is to retain this stature. In addition, its importance as a productive estuary and rearing place for other marine life must be retained. Similar protection is needed for other estuaries within the Coastal Basin.

Presently, there is no commercial hydroelectric power generation in the Coastal Basin; however, some electric power is generated at thermal plants at Astoria and North Bend. Most of the electric power requirements are satisfied by imports from other subregions. Potential hydroelectric sites are limited, but numerous potential pumped storage sites have been identified. Thermal generating plants utilizing ocean waters for cooling appear to be the most likely source of power generation.

Although not necessary to meet allocated food and fiber needs, several potential watershed projects have been identified which could be implemented under the regional development objective. These alternatives involve five reservoirs with 18,000 acre-feet of storage and 600 acres of surface area. The projects would provide 2,000 acre-feet for municipal and industrial use, 500 acre-feet for recreational use, irrigation water for nearly 11,000 acres of new land, and benefits to drainage, flood protection, and erosion control.

Under the environmental quality objective an accelerated, comprehensive program could be implemented by watershed and other development to reduce critical estuarine siltation by controlling surface and streambank erosion on a coastwide basis. This program was not included in the plan due to its undefined nature, extent, and timing.

Although the plan includes 14,000 MW of thermal electric power generation, the future situation may vary significantly from this amount depending upon dominant factors inherent in any one or a combination of the three objectives. The extremities of variation may range from no plants to a significantly larger installed capacity than included in the framework plan.

1970 to 1980 Program Included in the plan for the 1970 to 1980 period are two small watershed projects, Lake Creek and Floras Creek. These two projects would store 16,900 acre-feet and provide irrigation water for 8,300 acres. In addition, irrigation developments using natural flows of the Necanicum River and Beaver Slough would provide water for 1,200 acres. Private irrigation development using ground water and natural flows with farm pond storage would irrigate 1,300 acres. Supplemental water for 600 acres of land presently irrigated would be provided by Lake Creek and Floras Creek storage and natural flows of Beaver Slough.

Flood control measures would include a 1-mile levee for Elk Creek near Cannon Beach. Flood plain management programs would be implemented for all coastal streams. Protective measures should be implemented as early as possible in the Tillamook area.

Navigation improvements include completion of the south jetty at Tillamook, jetty and channel work to improve entrance conditions of the Umpqua River, channel improvements at Coos Bay and Siuslaw River, and improvement of the entrance and channel in Rogue River. Private development work has already begun to expand the small-boat basins at most of the coastal ports. Lower Columbia River navigation developments include maintenance of the deep-draft channel to Portland, improvement and expansion of port facilities at Astoria, and expansion of existing and construction of new small-boat moorages.

Municipal and industrial water supplies would be expanded to meet needs of this period by local and private development. Waste treatment must reach the 85 percent level by this time period. In addition, one thermal plant is included to generate 1.1 million kilowatts of electric power.

Recreation needs would be satisfied by expansion of existing camping and picnicking facilities and construction of new facilities by local, State, and Federal agencies. All or portions of the following streams are recommended for study for preservation in their free flowing state: Miami, Kilchis, North Fork Kilchis, Wilson, Trask, North Fork Trask, Nehalem, Nestucca, Little Nestucca, Salmon, Siletz, Alsea, Siuslaw, Smith, Sixes, Chetco, and Elk Rivers; and Lake Creek.

Long-Range Program During the 1980 to 2000 time period, irrigated land would be expanded by 3,300 acres with a storage project near Larson Slough supplying water for 400 acres and natural flows of Bear Creek, North Slough, Haynes Inlet supplying water for 1,500 acres. Private development utilizing ground water and natural flows with farm pond storage would irrigate an additional 1,400 acres.

Multiple-purpose storage projects at Fairview, Camas Valley, and Clear Creek to help meet recreational, flood control, water quality, and fish and wildlife needs are included in this time frame. Fairview and Camas Valley sites would store a total of 100,000 acre-feet of water on tributaries to Coquille River, and Clear Creek site would store 75,000 acre-feet on Nehalem River.

Navigation improvements would include the addition of three small-boat harbors along the coast and expansion of the existing small-boat facilities.

Waste treatment must reach the 90 percent level by 2000. Also included are thermal plants to generate 4,000 megawatts of electric power.

In the post 1980 period, municipal and industrial water supplies in the Lincoln County area must be augmented. Although the framework plan does not identify specific means of providing such supply, it is assumed that it would be provided through development of storage reservoirs and an extensive, coordinated distribution system.

Development of 8,900 acres of irrigated land with a project on the Nehalem River storing 22,000 acre-feet of water and scattered private irrigation development of 2,000 acres using natural streamflows and ground water would add a total of 10,900 acres of irrigated land to the coastal basin during the 2000 to 2020 time period. Also included are thermal plants to generate 10,000 megawatts of electric power.

Fort Rock, Christmas Lake, and Chewaucan Subarea (Subregion 12)

This portion of the Oregon Closed Basin contains five smaller internally drained areas. The three principal streams are: Silver Creek draining into Silver Lake; Ana River draining into Summer Lake; and Chewaucan River draining into Abert Lake. Because these lakes have a high alkaline content and are unusable for irrigation, domestic water, and most recreation, such uses are dependent on water supplied from natural flow, upstream storage, or ground-water development. The ground-water resource is extensive in the Fort Rock-Christmas Lake area.

Supplemental forage supply for livestock, the basin's primary need, would help to stabilize the economy. Winter feed (hay) shortages are the limiting factor in the production cycle. Irrigated pasture is needed to supplement range forage in extremely dry years. Nearly 34,000 acres of irrigated cropland which produce winter feed and supplementary summer pasture usually are short of irrigation water by July 15 and could be supplied from storage or ground-water development. About 27,000 acres of potentially irrigable land could be supplied from storage or ground water in watershed projects and individual developments. An estimated 914,000 acres of land are suitable for irrigated cropland if a need materializes and if a supply of water could be located.

Occasional spring or winter floods inundate a maximum of 30,000 acres and damage fences, roads, irrigation facilities, and buildings in rural places and the urban area of Paisley. Remedial measures are upstream storage or supplementary storage capacity in existing irrigation reservoirs, streambed dredging, levees through downstream reaches, or combinations of these measures. Flood plain zoning should be initiated in the Paisley area along the Chewaucan River to reduce flood damages. Land treatment and management practices such as erosion and sediment control, drainage, water conservation, and rangeland protection and management are required in many areas.

Forecasted electrical energy loads are expected to be relatively low and energy is expected to be imported. No problems are anticipated within the next 50 years for municipal or rural-domestic needs for water because of the low projected population expansion. Water quality is not expected to be a major problem; however, minor problems may develop from irrigation return flows and livestock waste. The recreation values are related to remote "open spaces"; water-related activities are not of high quality nor in great demand, but the demand could increase if some of the deterring effects were allevaited. Because hiking, hunting, nature walking, pleasure driving, and sightseeing are the most important activities on land, the greatest need is scenic trail and road development.

The Chewaucan River has the basin's best sport fishery, but trout are found in nearly all perennial streams and fresh water lakes including Thompson Valley and Ana Reservoirs. Measures to insure adequate minimum streamflows are required to protect the resource. Artificial propagation of fish would probably be needed to offset the increased fishing pressure. Mule deer populate the basin in large numbers, and a few pronghorn antelope range throughout. The Silver Lake-Fort Rock area is a key winter range for mule deer and upland game birds. Summer Lake Wildlife Management Area is an important waterfowl habitat area, and the Silver Lake area is a potential high quality perennial waterfowl area. Extensive environmental values pertain to the wild, undeveloped status and

the means to maintain this condition, including the preservation of historical, archeological, and ecological resources.

An alternative to irrigate all potential irrigable cropland in the five planned watershed projects appeared undesirable because such extensive development is not needed to meet allocated food and fiber needs and because sufficient knowledge concerning source of water is not available. Weather modification was also considered but was not included in the plan because of insufficient knowledge about the full impact such a program would have on the environment.

Although not necessary to meet allocated needs, a potential reservoir on the Chewaucan River, the Coffeepot Project, could provide storage to supply water to irrigate land within the Chewaucan Irrigation District. A secondary function would be to supply flood control benefits at Paisley.

<u>1970 to 1980 Program</u> The plan for the early period includes three watershed projects. Sixteen hundred acre-feet of storage on Buck Creek and 12,000 acre-feet on Crooked Creek would provide flood protection on about 18,000 acres of rural land in these watersheds. From this storage almost 10,000 acres of inadequately irrigated land and 1,000 acres of new land would receive a full supply. The Fort Rock project would provide 5,900 acres of new land with a full irrigation supply. Basinwide, approximately 7,500 acres of cropland with a wetness problem would be drained to increase productivity.

Other programs of governmental agencies and private development would meet projected needs for municipal and industrial water supply, water quality, recreation, flood control, irrigation, fish, and wildlife. Some of the specific measures would be to establish erosion and sediment control on more than 100,000 acres of land. A flood plain management plan would be initiated in the Paisley area along the Chewaucan River.

<u>Long-Range Program</u> Subsequent years would see a continuation of the land treatment and watershed protection measures. The plan for the 1980 to 2000 time period includes two projects (Silver Lake and Chewaucan River) to develop 9,800 acres of new irrigated land and to supply 18,700 acres of inadequately irrigated land with supplemental water. Local and private efforts are expected to develop ground-water sources to supply an additional 4,000 acres of new land and 1,100 acres of inadequately served land. Other developments are: drainage of cropland, 8,000 acres; flood protection, about 15,000 acres of rural land and 200 acres of urban land; recreation, over 12,000 recreation days of use.

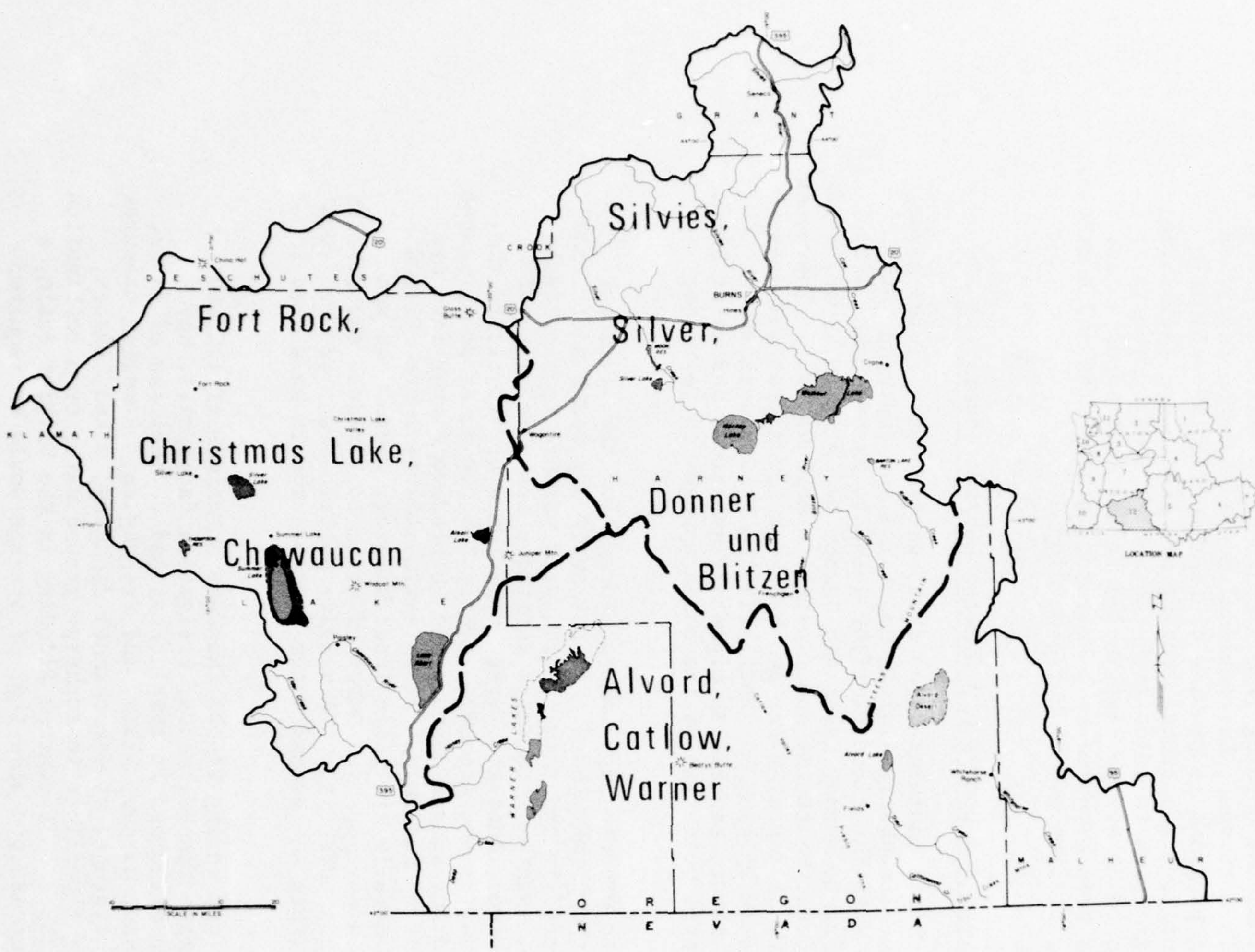
No specific projects are planned in the 2000 to 2020 time period; however, the ongoing land treatment and watershed protection programs would continue. Recreational needs would be fulfilled by continuing programs to provide or improve fish and wildlife habitat, to provide additional camping and picnicking facilities, and to provide means to enjoy esthetic recreational pursuits. Scenic access roads may be constructed to the Lost Forest Area. This area has been proposed as a Research Natural Area and a management plan for visitor use is being developed.

Silvies, Silver, and Donner und Blitzen Subarea (Subregion 12)

This subarea contains three drainage systems--Silvies River, heading in the Strawberry-Aldrich Mountains and emptying into Malheur Lake with the flood overflow going to Harney Lake; Silver Creek, draining to Harney Lake; and Donner und Blitzen River, heading in the Steens Mountains and flowing to Malheur Lake. The water in Harney Lake is too alkaline and brackish for almost all uses. The 184,000-acre Malheur National Wildlife Refuge supports an abundance of birds, especially migratory waterfowl and water birds. The ground-water potential of the basin appears to be rather extensive.

Water to produce supplemental forage for the livestock industry is the primary need. In extremely dry years additional forage is needed in the form of irrigated pasture to supplement range forage. Winter feed (hay) shortages could be alleviated in this way also. Adequate forage supplies would stabilize the livestock industry and economy. Nearly 179,000 acres of irrigated cropland used for summer pasture and to produce winter feed are short of water by mid-July. It is estimated there are 671,600 acres of potentially irrigable land; however, there does not appear to be a developable source of water to irrigate the greater portion of this potential. A smaller portion might be developed from both surface and ground water if there should be a need in the future.

Winter and spring floods inundate a maximum of 115,000 acres and damage fences, roads, irrigation facilities, hay supplies, and buildings in rural areas and communities of Burns, Hines, Buchanan, Harney, Riley, and Frenchglen. Remedial measures are upstream storage, stream channel dredging, dikes, levees, and spreading floodflows to recharge ground water, or a combination of these measures. To control flooding in the Silvies Basin, a total of about 180,000 acre-feet of storage would be required. If protection is not provided through storage, dikes and levees could be constructed along the Silvies River from the vicinity of Burns to confluence with Malheur Lake. Flood plain zoning ordinances should be initiated by local governments in Burns and



COLUMBIA–NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

PLAN FORMULATION SUBAREAS

OREGON CLOSED BASIN
SUBREGION 12

FIGURE 20

Hines to reduce flood damages. Land treatment and watershed protection measures--water conservation, drainage, erosion and sediment control, and rangeland protection and management--are required in many areas.

Increases in electrical energy loads are expected to be relatively low so energy can be imported. Municipal and rural-domestic water uses amount to about 1.3 million gallons per day (mgd) each and industrial use is 1.4 mgd. The use is expected to increase by 2020 as follows: municipal, 200 percent; rural-domestic, 100 percent; and industrial, almost no increase. No major waste treatment problems exist and none are expected to develop; however, minor problems could develop from irrigation return flows and from livestock waste.

The Malheur National Wildlife Refuge and the Steens Mountain area offer popular recreation activities such as hiking, rock and gem collecting, sightseeing, horseback riding, pleasure driving, wildlife observation, and photography. A variety of fish and wildlife, including resident trout, warm water fish, upland game and game birds, big game, and waterfowl inhabit the basin. Key big game winter range areas are located near Silver Lake, Moon Reservoir, along Silvies River east of Burns to Cow Creek, upper Silvies area, Barton Lake Reservoir, Frenchglen, and upper Donner und Blitzen River. Upland game birds are most abundant in range areas but some inhabit irrigated agricultural areas and would continue to supply recreational hunting if the habitat is protected. Future fishing needs can best be met by maintaining present flows and water quality and by preserving some streams for their present and potential values as fish habitat. Artificial propagation of fish would probably be necessary to offset the increased fishing pressure. Study and detailed planning are necessary to determine the needs for preservarion and/or enhancement of the historical, archeological, and ecological resources and the natural environment.

Development possibilities range from the extremes of total development of the agricultural potential to that of no development. Subregional development objectives probably would be characterized by a higher-than-planned and lower-than-potential level of irrigation development and flood control to be provided generally by surface-water storage.

In any case, early identification of the extent and availability of ground water and the effects of surface and ground-water withdrawals on the operation of Malheur Lake are highly desirable. Accordingly, the following tentative premises are suggested: (1) development of ground water is preferable to surface water and (2) the ground-water resource generally is adequate to meet the area's projected developmental needs. In

the interim, until completion of such a study, actions should insure that Malheur Lake will be maintained essentially in its present condition.

The primary alternative to the extensive ground-water development recommended centers around two possible reservoir sites--the 200,000 acre-foot Canyon Reservoir on Silvies River and the 50,000 acre-foot Bear Creek Reservoir on Bear Creek. Variations to this alternative utilize one or both reservoirs to provide 24,000 to 120,000 acre-feet of storage for irrigation and increased flood control but have been a subject of controversy regarding possible adverse effects upon Malheur Lake.

Development of surface storage as an alternative for ground water in the Willow Creek and Poison Creek watershed projects is another possibility. Several reservoirs would be included to impound about 240,000 acre-feet and provide irrigation, flood protection, drainage, and recreation benefits. However, being located on tributaries to the Silvies River and Malheur Lake, this storage would pose the same problems as storage on Silvies River.

Another alternative would be to develop the total irrigation potential possible in watershed projects included in the recommended plan. Larger storage facilities or greater ground-water development would be necessary. New development in the Bear Valley watershed could provide irrigation, flood prevention, drainage, erosion control, and recreation. Storage facilities would provide the water supply. This increased development, however, was not needed to meet the identified needs.

Another possibility is modification of the weather to control the amount and timing of precipitation, thereby providing water for agricultural uses and controlling flooding. Weather modification was not included in the plan, because little is known about the full impact such a program would have on the environment.

<u>1970 to 1980 Program</u> Irrigation elements of the plan for the early period include one watershed project and private development. Specifically, the Willow Creek project would provide supplemental irrigation water to 43,800 acres of cropland from ground-water sources, and development of ground water by private interests would insure a full supply of water to 11,200 acres of presently irrigated cropland. Should ground-water sources prove inadequate, the needs would have to be satisfied by alternative means or by development in other subregions. Dikes, levees, and channel improvement would provide minimal flood protection on 45,000 acres of rural land and 300 acres of urban area.

Other agency programs and private development would meet projected needs in the following functions: municipal and industrial water, water quality, recreation, flood control, irrigation, land treatment, fish, and wildlife. Flood plain management efforts should be implemented in the Burns-Hines area. Drainage of 8,200 acres of cropland and erosion and sediment control on about 100,000 acres of land would be provided. The following streams would be considered for preservation for their values as fish habitat: Donner und Blitzen and Silvies Rivers, and Silver and Poison Creeks. Streams recommended for improvement by construction of gabions or sills to stabilize streambeds, create pools and riffles, and maintain channels are: Bear, Augur, Bridge, and Elder Creeks.

Long-Range Program The plan for the 1980 to 2000 time period includes three federally assisted projects (Poison Creek, Upper Silver Creek, and Miller Canyon) to supply inadequately irrigated land with supplemental water, 42,200 acres from ground water and 7,100 acres from stored water in the Silver Creek drainage. Storage on Silver Creek could affect a portion of the Malheur National Wildlife Refuge which depends upon this source of water. Private interests are expected to develop ground water for 12,800 acres of cropland to supplement present supplies. Subsequent years would see a continuation of the land treatment and watershed protection measures. Benefits are: drainage of cropland, 3,600 acres; flood protection, 20,000 acres; and recreation, over 10,000 recreation days of use. Municipal and industrial water requirements would continue to be met from ground-water sources.

No specific projects are planned in the 2000 to 2020 time period; however, the ongoing land treatment and watershed protection programs would continue. The recreation needs would be fulfilled by continuing programs to provide or improve fish and wildlife habitat, to provide additional camping and picnicking facilities, and to provide the means to enjoy esthetical recreation pursuits. Scenic access roads would be constructed to the Steens Mountain and Aldrich-Strawberry Mountains areas.

Alvord, Catlow, and Warner Subarea (Subregion 12)

Also a portion of the Oregon Closed Basin, this subarea contains three smaller closed basins. Most streams are intermittent. The exceptions are: Oregon Canyon Creek, flowing into Nevada; Trout Creek, flowing into Alvord Lake; Honey Creek, flowing into Hart Lake; and Twentymile and Deep Creeks, flowing into Crump Lake. Ground water is available in the Oregon Canyon, Alvord Lake, and Warner Lakes areas.

About 79,600 acres of cropland, 75,700 of which are irrigated, produce hay and pasture forage to supplement the almost 4 million acres of rangeland utilized in the livestock enterprise. However, in extremely dry years the present forage supply, in the form of summer pasture, is inadequate and, in addition, winter feed (hay) shortages occur. Approximately 57,000 acres of irrigated cropland are short of water by July 15. Either additional land must be irrigated or supplemental supplies provided to the present inadequately irrigated land to alleviate this situation. Such an effort would tend to stabilize the livestock industry and the basin economy. Over 1.5 million acres of land are potentially irrigable; however, a developable source of water is not available for the greatest proportion of this acreage.

Although runoff from snowmelt and convectional storms flood a maximum of 34,600 acres, damage is usually not significant because of cropping pattern and minimal development in the flood plains. The major flood problem occurs in the Warner Lakes area when excessive spring runoff raises the water levels in the lakes and inundates the surrounding lowlands. Land treatment and management practices--drainage of cropland, erosion and sediment control, water conservation, and rangeland protection and management--are necessary in many areas.

Increases in electrical energy loads are expected to be relatively low and could be imported from other basins. Municipal and industrial needs for water would continue to be insignificant. Rural-domestic needs would nearly double by 2020 and can be satisfied by individual ground-water systems. No serious waste treatment problems are expected; however, minor problems could develop from irrigation return flows and livestock waste.

Because the recreational potential is characterized by remoteness, suitable areas with primitive and natural values and "wide-open spaces" should be preserved and access roads and trails should be constructed to these places of interest. Because fishing is the major recreational activity on perennial streams, intensive management is necessary to maintain the present and future sport fishery resource. Artificial propagation of fish will probably be necessary to offset the increased fishing pressure. Hunting needs are expected to increase by 196,000 hunter-days from 1970 to 2020 and the esthetic and nonhunting uses of wildlife are expected to increase many times. Where possible, land should be developed and managed in a manner compatible with wildlife production; key game habitat must be preserved; big game winter range must be protected; and watering facilities must be constructed. A multiple-use plan for wildlife management in the north portion of Warner Valley involving 25,000 acres of public land and 37,500 acre-feet of stored water would provide a major increase in waterfowl hunting.

Although the plan meets allocated food and fiber needs, a regional development alternative is to develop the total potential irrigable cropland in four of the planned watershed projects with 5,000 acres supplied from enlarged storage facilities and 11,000 acres supplied from greater ground-water development. The Trout Creek watershed project could irrigate 3,000 acres from storage and 2,000 acres from ground water. The Whitehorse project could develop an additional 1,000 acres from storage and 4,000 acres from ground water. Oregon Canyon project has a potential for 5,000 acres of irrigated cropland development from ground water. Greater storage capacity in Hart Lake watershed could be utilized to irrigate 1,000 acres of new cropland.

Weather modification was also considered but not included in the plan because of insufficient knowledge about the full impact such a program would have on environment.

1970 to 1980 Program Development in this time frame includes ground water to supply 8,200 acres of irrigated cropland with late season water. A project would enable the ranchers of the Oregon Canyon watershed to secure additional water for 2,200 acres from ground-water sources. Individual systems would enable other ranches to supplement irrigation on 6,000 acres of cropland.

Other agency programs and private development would meet projected needs for water quality, recreation, flood control, land treatment, fish, and wildlife. Land treatment and watershed protection measures are: drainage of 300 acres of cropland, about 100,000 acres of erosion and sediment control, and an estimated 700,000 acres of rangeland protection and management. Municipal, industrial, wildlife, environmental quality, waste treatment, and power needs would be met. All of four streams--Deep, Twelvemile, Honey, and Trout Creeks--would be considered for preservation for their present and potential values as fish habitat. Burnt, Dismal, and Willow Creeks could be improved for trout by construction of gabions or sills to stabilize streambeds, create pools and riffles, and maintain channels.

Long-Range Program The plan for the 1980 to 2000 time frame includes five small watershed projects (Trout Creek, Hart Lake, Deep Creek, Whitehorse Creek, and Twentymile Creek). The projects would provide water to convert 14,000 acres of rangeland into irrigated cropland, 7,300 acres with ground water and 6,700 acres with stored water. Supplementary supplies would also be provided to 28,700 acres of irrigated cropland, 1,700 acres from ground water and 27,000 acres from reservoir storage. Private interests would develop ground water to irrigate 1,000 acres of new land and to supply 8,500 acres of presently irrigated cropland with a late season supply.

This time period would see a continuation of the land treatment and watershed protection measures. Conservation installations include: drainage on 10,400 acres of cropland, flood control on 150,000 acres, and rangeland protection and management practices on 600,000 acres. Programs to improve big game winter range would be continued. Stabilized water conditions and improved livestock grazing distribution provided by this program would result in improved wildlife habitat over a large area. Water would be obtained from Honey Creek and overflow from Hart Lake. The multiple-use wildlife plan for the northern portion of Warner Valley would be implemented.

No specific projects are planned in the 2000 to 2020 time frame; however, the ongoing land treatment and watershed protection programs would continue. Private interests are expected to sponsor only minimal activity. Recreational needs would be fulfilled by continuing programs to provide additional camping and picnicking pursuits. Scenic access roads would be constructed to the Warner Lakes and Steens Mountain areas.

Area Plans and Programs

The composition of the framework plan is summarized in table 77 for subregions and the area. The following discussion described elements of the plan.

Electric Power

Table 78 lists the planned hydroelectric and thermal electric installations by time period and subregion.

Hydroelectric Power Under the Columbia River Treaty previously described, 15,500,000 acre-feet of storage is being developed in Canada for power and other uses. Construction of additional peaking capacity is underway or planned at many Columbia River plants. Table 79 shows those additions in Area C as well as the small plants which are planned on tributary streams. The development of these sites will, with few exceptions, exhaust the supply of economically feasible conventional hydroelectric sites.

Thermal Power A considerable amount of thermal power generation is planned in this area because of its large projected needs for electric power, particularly in the Willamette Subregion. It is planned to make maximum use of power producing capabilities along the Columbia River east of the Cascades where water resources

Table 77 — Framework Plan Composition, Area C

Purpose or Function	Units	Subregion 7				Subregion 9 1/				Subregion 10s				Subregion 12			
		1970-1980	1981-2000	2001-2020	Total	1970-1980	1981-2000	2001-2020	Total	1970-1980	1981-2000	2001-2020	Total	1970-1980	1981-2000	2001-2020	Total
Water Development and Control																	
Electric Power																	
Hydro	MW	0	1,480	0	1,480	0	75	0	75	49	0	0	49	0	0	0	0
Thermal	MW	1,100	13,900	25,000	40,000	0	5,000	19,000	24,000	0	4,000	10,000	14,000	0	0	0	0
Consumptive use	1,000 Ac. Ft.	23	264	437	724	0	97	319	416	0	1	2	3	0	0	0	0
Navigation																	
Locks	Number	1	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0
Channels	Miles	0	0	0	0	0	106	0	106	36	0	0	36	0	0	0	0
Breakwaters	Miles	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0
Water Quality Control																	
Raw Waste Production 2/	1,000 PE	594	820	1,071	2,485	67	2,796	3,474	6,203	747	718	712	2,177	5	11	19	35
Waste Removal 2/	1,000 PE	645	854	964	2,463	74	2,831	3,126	5,883	1,352	779	641	2,772	2	12	17	31
M&I Water Supply	MGD	34	48	55	137	164	309	517	990	81	94	62	237	2	2	3	7
Municipal	MGD	(8)	(24)	(22)	(54)	(127)	(202)	(357)	(686)	(11)	(27)	(34)	(72)	(1)	(0)	(2)	(3)
Industrial	MGD	(22)	(16)	(26)	(64)	(32)	(101)	(152)	(285)	(68)	(64)	(26)	(158)	(0)	(1)	(0)	(1)
Rural-Domestic	MGD	(4)	(8)	(7)	(19)	(5)	(6)	(8)	(19)	(2)	(3)	(2)	(7)	(1)	(1)	(1)	(3)
Diversions and Withdrawals	1,000 Ac. Ft.	38	53	62	153	183	348	578	1,109	91	105	69	265	3	1	4	8
Flood Control																	
Management Areas	Number	6	0	0	6	9	0	0	9	8	0	0	8	2	0	0	2
Major Stream Control (channels and levees)	Miles	4	29	17	50	52	149	75	276	1	118	0	119	0	0	0	0
Single-Purpose Storage	1,000 Ac. Ft.	6	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation																	
New	1,000 Ac.	307	90	272	669	186	420	150	756	66	4	22	92	7	34	0	41
Supplemental	1,000 Ac.	95	128	14	237	26	0	0	26	10	0	8	18	77	119	0	196
Diversions and Withdrawals	1,000 Ac. Ft.	1,537	410	1,006	2,953	589	1,034	268	1,891	244	8	72	324	116	256	0	372
Multipurpose Reservoir Storage Capacity	1,000 Ac. Ft.	958	502	272	1,732	933	1,282	701	2,916	858	803	29	1,690	14	111	0	125
Water and Related Land Programs																	
Fish																	
Habitat Preservation Streams	Miles	800	200	150	1,150	600	180	120	900	1,000	300	200	1,500	270	80	50	400
Habitat Improvement:																	
Streams	Miles	718	1,532	2,232	4,482	810	1,050	860	2,720	776	2,511	3,515	6,802	898	1,146	1,140	3,184
Lakes	1,000 Ac.	13	32	46	91	10	11	11	32	8	33	32	73	2	3	3	8
Harvest																	
Stream Access	Miles	330	250	238	818	130	150	95	375	315	360	225	900	18	20	12	50
Lake Access	Sites	77	46	33	156	30	25	25	80	50	66	50	166	10	16	10	36
Saltwater Access	Sites	0	0	0	0	0	0	0	0	20	25	20	65	0	0	0	0
Augmentation of Supply																	
Hatcheries 3/	Number	5	4	7	16	2	0	4	6	4	9	5	18	0	0	0	0
Rearing Ponds	Acres	100	125	150	375	800	1,600	1,600	4,000	100	175	150	425	0	0	0	0
Wildlife																	
Land Acquisition	1,000 Ac.	181	162	157	500	18	9	15	42	16	21	14	51	19	46	7	72
Habitat Improvement	1,000 Ac.	216	357	427	1,000	42	33	20	95	43	68	170	281	73	49	65	187
Improved Hunting Access	1,000 Ac.	2,350	3,134	2,350	7,834	1,045	1,393	1,045	3,483	1,531	2,041	1,531	5,103	512	682	512	1,706
Augmentation of Supply																	
Game Birds	1,000 No.	22	11	16	49	0	0	0	0	0	0	0	0	0	0	0	0
Outdoor Recreation (Water Related)																	
Recreation Development	1,000 R. Days	2,900	7,500	13,300	23,700	9,200	13,200	23,900	46,300	4,600	13,400	23,700	41,700	400	700	1,200	2,300
Water Surface Use	Acres	3,400	14,900	26,100	44,400	29,000	41,000	73,000	143,000	9,300	28,100	50,200	87,600	400	1,000	1,700	3,100
Land Area (Rec. Facility Develop.)	Acres	1,200	2,800	6,000	10,000	12,300	12,000	24,600	48,900	4,500	5,900	11,700	22,100	100	100	200	400
Urban Land Acquisition	Acres	0	0	1,000	1,000	5,300	7,400	14,600	27,300	0	3,000	6,900	9,900	0	0	100	100
Boat Launch Areas	No. of Lanes	10	85	170	265	293	810	1,439	2,542	60	165	300	525	5	5	10	20
Related Land Programs																	
Nonstructural																	
Erosion and Sediment Control	1,000 Acres	1,168	1,819	2,280	5,267	127	202	197	526	178	302	295	775	311	460	440	1,211
Water Conservation	1,000 Acres	310	90	282	682	173	407	146	726	54	6	21	81	7	3	6	16
Protection & Management	1,000 Acres	9,180	9,103	8,313	NA	5,228	5,061	5,092	NA	10,140	10,115	10,081	NA	2,299	1,848	1,811	NA
Water Yield Improvement	1,000 Acres	16	24	49	89	2	4	5	11	1	2	1	4	1	2	2	5
Structural																	
Drainage	1,000 Acres	8	16	16	40	84	105	106	295	34	43	45	122	16	22	22	60
Trib. Stream Control (flood control)																	
Bank Stabilization	Miles	484	690	720	1,894	208	80	79	367	404	503	431	1,335	150	228	227	605
Dikes and Levees	Miles	148	205	202	555	16	21	21	58	220	294	296	810	93	132	135	360
Channel Improvement	Miles	639	765	729	2,133	420	196	192	808	1,614	1,576	1,052	4,242	134	204	210	548
Erosion Control Structures	No.	3,286	6,040	2,125	11,451	2	3	2	7	545	2,134	3,446	6,125	1,315	1,046	1,237	3,598
Ponds and Small Reservoirs	No.	1,731	1,690	2,130	5,551	774	1,807	607	3,188	104	436	569	1,109	1,641	2,708	2,715	7,064
	1,000 Ac. Ft.	4	9	8	21	5	11	6	22	2	2	2	6	25	27	17	69
Studies																	
Coastal Zone and Estuaries																	
Estuarine Management	No.	--	--	--	--	--	--	--	--	22	--	--	22	--	--	--	--
Estuarine Management	1,000 Acres	--	--	--	--	--	--	--	--	57	--	--	57	--	--	--	--
Beach Management	Miles	--	--	--	--	--	--	--	--	256	--	--	256	--	--	--	--
Beach Stabilization	Miles	--	--	--	--	--	--	--	--	64	102	--	166	--	--	--	--
River Basin	No.	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1
Watersheds	No.	38	29	0	67	49	23	0	72	20	9	0	29	12	4	0	16
Special:																	
Preservation of Streams	Miles	874	0	0	874	1,250	0	0	1,250	987	0	0	987	0	0	0	0
Scenic Roads	Miles	1,008	0	0	1,008	398	0	0	398	840	0	0	840	652	0	0	652
Roadless Areas	1,000 Acres	0	0	0	0	5	0	0	5	119	0	0	119	231	0	0	231
Minimum Flows	No.																
Other	No.																

1/ Data from Willamette Basin Type 2 Study or based upon basic Type 2 data adjusted to C-NP definitions and assumptions.

2/ Includes municipal, industrial, and recreation uses.

3/ Does not include hatcheries required as mitigation features of reservoir projects.

Table 77 — Framework Plan Composition, Area C

	Subregion 7				Subregion 9 1/				Subregion 10s				Subregion 12				Area Total			
s	1970-1980	1981-2000	2001-2020	Total	1970-1980	1981-2000	2001-2020	Total	1970-1980	1981-2000	2001-2020	Total	1970-1980	1981-2000	2001-2020	Total	1970-1980	1981-2000	2001-2020	Total
	0	1,480	0	1,480	0	75	0	75	49	0	0	49	0	0	0	0	49	1,555	0	1,604
	1,100	13,900	25,000	40,000	0	5,000	19,000	24,000	0	4,000	10,000	14,000	0	0	0	0	1,100	22,900	54,000	78,000
0 Ac. Ft.	23	264	437	724	0	97	319	416	0	1	2	3	0	0	0	0	23	362	759	1,144
ber	1	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0	2
	0	0	0	0	0	106	0	106	36	0	0	36	0	0	0	0	36	106	0	142
	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	2	0	0	2
0 PE	594	820	1,071	2,485	67	2,796	3,474	6,203	747	718	712	2,177	5	11	19	35	1,279	4,345	5,276	10,900
0 PE	645	854	964	2,463	74	2,831	3,126	5,883	1,352	779	641	2,772	2	12	17	31	1,925	4,476	4,748	11,149
)	34	48	55	137	164	309	517	990	81	94	62	237	2	2	3	7	281	453	637	1,371
)	(8)	(24)	(22)	(54)	(127)	(202)	(357)	(686)	(11)	(27)	(34)	(72)	(1)	(0)	(2)	(3)	(147)	(253)	(415)	(815)
)	(22)	(16)	(26)	(64)	(32)	(101)	(152)	(285)	(68)	(64)	(26)	(158)	(0)	(1)	(0)	(1)	(122)	(182)	(204)	(508)
)	(4)	(8)	(7)	(19)	(5)	(6)	(8)	(19)	(2)	(3)	(2)	(7)	(1)	(1)	(1)	(3)	(12)	(18)	(18)	(48)
0 Ac. Ft.	38	53	62	153	183	348	578	1,109	91	105	69	265	3	1	4	8	315	507	713	1,535
ber	6	0	0	6	9	0	0	9	8	0	0	8	2	0	0	2	25	0	0	25
	4	29	17	50	52	149	75	276	1	118	0	119	0	0	0	0	57	296	92	445
0 Ac. Ft.	6	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	6
0 Ac.	307	90	272	669	186	420	150	756	66	4	22	92	7	34	0	41	566	548	444	1,558
0 Ac.	95	128	14	237	26	0	0	26	10	0	8	18	77	119	0	196	208	247	22	477
0 Ac. Ft.	1,537	410	1,006	2,953	589	1,034	268	1,891	244	8	72	324	116	256	0	372	2,486	1,708	1,346	5,540
0 Ac. Ft.	958	502	272	1,732	933	1,282	701	2,916	858	803	29	1,690	14	111	0	125	2,763	2,698	1,002	6,463
	800	200	150	1,150	600	180	120	900	1,000	300	200	1,500	270	80	50	400	2,670	760	520	3,950
	718	1,532	2,232	4,482	810	1,050	860	2,720	776	2,511	3,515	6,802	898	1,146	1,140	3,184	3,202	6,239	7,747	17,188
0 Ac.	13	32	46	91	10	11	11	32	8	33	32	73	2	3	3	8	33	79	92	204
	330	250	238	818	130	150	95	375	315	360	225	900	18	20	12	50	793	780	570	2,143
	77	46	33	156	30	25	25	80	50	66	50	166	10	16	10	36	167	153	118	438
	0	0	0	0	0	0	0	0	20	25	20	65	0	0	0	0	20	25	20	65
ber	5	4	7	16	2	0	4	6	4	9	5	18	0	0	0	0	11	13	16	40
s	100	125	150	375	800	1,600	1,600	4,000	100	175	150	425	0	0	0	0	1,000	1,900	1,900	4,800
0 Ac.	181	162	157	500	18	9	15	42	16	21	14	51	19	46	7	72	234	238	193	665
0 Ac.	216	357	427	1,000	42	33	20	95	43	68	170	281	73	49	65	187	374	507	682	1,563
0 Ac.	2,350	3,134	2,350	7,834	1,045	1,393	1,045	3,483	1,531	2,041	1,531	5,103	512	682	512	1,706	5,438	7,250	5,438	18,126
0 No.	22	11	16	49	0	0	0	0	0	0	0	0	0	0	0	0	22	11	16	49
0 R. Days	2,900	7,500	13,300	23,700	9,200	13,200	23,900	46,300	4,600	13,400	23,700	41,700	400	700	1,200	2,300	17,100	34,800	62,100	114,000
s	3,400	14,900	26,100	44,400	29,000	41,000	73,000	143,000	9,300	28,100	50,200	87,600	400	1,000	1,700	3,100	42,100	85,000	151,000	278,100
s	1,200	2,800	6,000	10,000	12,300	12,000	24,600	48,900	4,500	5,900	11,700	22,100	100	100	200	400	18,100	20,800	42,500	81,400
s	0	0	1,000	1,000	5,300	7,400	14,600	27,300	0	3,000	6,900	9,900	0	0	100	100	5,300	10,400	22,600	38,300
of Lanes	10	85	170	265	293	810	1,439	2,542	60	165	300	525	5	5	10	20	368	1,065	1,919	3,352
0 Acres	1,168	1,819	2,280	5,267	127	202	197	526	178	302	295	775	311	460	440	1,211	1,784	2,783	3,212	7,779
0 Acres	310	90	282	682	173	407	146	726	54	6	21	81	7	3	6	16	544	506	455	1,505
0 Acres	9,180	9,103	8,313	NA	5,228	5,061	5,092	NA	10,140	10,115	10,081	NA	2,299	1,848	1,811	NA	26,847	26,127	25,297	NA
0 Acres	16	24	49	89	2	4	5	11	1	2	1	4	1	2	2	5	20	32	57	109
0 Acres	8	16	16	40	84	105	106	295	34	43	45	122	16	22	22	60	142	186	189	517
	484	690	720	1,894	208	80	79	367	404	503	431	1,335	150	228	227	605	1,246	1,498	1,457	4,201
	148	205	202	555	16	21	21	58	220	294	296	810	93	132	135	360	477	652	654	1,783
	639	765	729	2,133	420	196	192	808	1,614	1,576	1,052	4,242	134	204	210	548	2,807	2,741	2,183	7,731
	3,286	6,040	2,125	11,451	2	3	2	7	545	2,134	3,446	6,125	1,315	1,046	1,237	3,598	5,148	9,223	6,810	21,181
	1,731	1,690	2,130	5,551	774	1,807	607	3,188	104	436	569	1,109	1,641	2,708	2,715	7,064	4,250	6,641	6,021	16,912
0 Ac. Ft.	4	9	8	21	5	11	6	22	2	2	2	6	25	27	17	69	36	49	33	118
	--	--	--	--	--	--	--	--	22	--	--	22	--	--	--	--	22	--	--	22
0 Acres	--	--	--	--	--	--	--	--	57	--	--	57	--	--	--	--	57	--	--	57
	--	--	--	--	--	--	--	--	256	--	--	256	--	--	--	--	256	--	--	256
	--	--	--	--	--	--	--	--	64	102	--	166	--	--	--	--	64	102	--	166
	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1	1	--	--	1
	38	29	0	67	49	23	0	72	20	9	0	29	12	4	0	16	119	65	0	184
	874	0	0	874	1,250	0	0	1,250	987	0	0	987	0	0	0	0	3,111	0	0	3,111
	1,008	0	0	1,008	398	0	0	398	840	0	0	840	652	0	0	652	2,898	0	0	2,898
0 Acres	0	0	0	0	5	0	0	5	119	0	0	119	231	0	0	231	355	0	0	355
																	1	--	--	1
																	6	--	--	6

d upon basic Type 2 data adjusted to C-NP

s.

n features of reservoir projects.

2

and low population densities combine to make the most favorable sites. In this area, power production is planned up to the capacity of the existing transmission corridors over the Cascade Range. It is assumed that the corridors would be reconductored for maximum transmission. The plan is essentially the alternative described in Appendix XV, Electric Power, for maximum loads in Subregions 9 and 11, minimum hydro development and maximum thermal installation east of the Cascades up to the limits of existing transmission corridors.

Most of the thermal plants would incorporate evaporative type cooling systems. For these plants, diversions of water would equal the consumptive water requirements shown in table 80. However, along the coast where unlimited supplies of salt water are available, direct cooling with ocean water is planned for thermal installations. Although not a specific planned program, there is a good possibility of using thermal electric cooling water for irrigation in some locations.

Table 78 - Phasing of Power Installations, Area C1/

	1970			1971-1980		1981-2000		2001-2020	
Subregion	Existing	Under Const.	Total	Added	Total	Added	Total	Added	Total
				(installation in megawatts)					
Subregion 7									
Hydro	4,338	1,498	5,836	0	5,836	1,480	7,300 2/	0	7,300
Thermal	0	0	0	1,100	1,100	13,900	15,000 2/	25,000	40,000
Subregion 9									
Hydro	702	0	702	0	702	75	800 2/	0	800
Thermal	146	0	146	0	146	5,000	5,000 2/	19,000	24,000
Subregion 10S									
Hydro	250	0	250	49	299	0	300 2/	0	300
Thermal	25	0	25	0	25	4,000	4,000 2/	10,000	14,000
Subregion 12									
Hydro	0	0	0	0	0	0	0	0	0
Thermal	0	0	0	0	0	0	0	0	0
Area C									
Hydro	5,290	1,498	6,788	49	6,837	1,555	8,400	0	8,400
Thermal	171	0	171	1,100	1,271	22,900	24,000	54,000	78,000
Total	5,461	1,498	6,959	1,149	8,108	24,500	32,400	54,000	86,400

1/ Nameplate ratings.
2/ After 1980, all existing small thermal plants would be retired, hydro capacity rounded to nearest 100 mw by subregion.

Table 79 - Planned Additions to Existing Projects, Area C

Project	Additional Capacity 1970-1980	1981-2000	2001-2020
		(megawatts)	
Subregion 7			
McNary	0	420	0
John Day	0	540	0
Bonneville	0	480	0
Nine Foot Creek	0	40	0
Total	0	1,480	0
Subregion 9			
Cougar (Incl. Rereg.)	0	40	0
Shellrock	0	35	0
Total	0	75	0
Subregion 10S			
Lost Creek	49	0	0
Total	49	0	0
Subregion 12			
None	0	0	0
Area C	49	1,555	0

Table 80 - Planned Thermal Power and Water Requirements, Area C

Subregion	Thermal Installations 1980	2000	2020	Annual Water Requirements 1980	2000	2020
		(megawatts)			(1,000 ac-ft)	
7	1,100	15,000	40,000	23	287	724
9	0	5,000	24,000	0	97	416
10S	1,100	4,500	14,000	0	1 1/	4 1/
12	0	0	0	0	0	0
Total	2,200	24,500	78,000	23	385	1,144

1/ Fresh water only.

Power from Pumped Storage Although large thermal plants are expected to satisfy a major portion of the future power load, their inability to supply economical peaking power will result in the development of pumped storage or other types of peaking plants. Studies indicate that the peaking requirements of the region will be met until about 1990 by adding generating units at existing conventional hydroelectric projects. When addition of those units is completed, other sources of peaking power must be developed. Many pumped storage sites exist and are shown in Appendix XV, Electric Power. The Type 2 Willamette Basin Study covering Subregion 9 included six in its plan. However, since a regionwide

plan for installation of peaking units is not available and location of those plants is flexible within the region to a certain extent, pumped storage projects have not been included in the plan for this area.

Navigation

Mid Columbia River navigation developments for the 1970 to 1980 time period include lock approach modifications and removal of shoal areas and other obstructions to navigation. Modifications of the approach zones to the locks at Bonneville, John Day, and McNary Dams would shorten travel time. Bonneville Lock would be enlarged to increase its size to equal or exceed the three upriver locks, thereby reducing shipping costs.

After passing Bonneville, tows are sometimes remade into larger units, but this adds to the cost of transit. Removal of shoal areas in the upper reaches of Lakes Umatilla and Wallula would permit increased speed and full vessel loading throughout the year. Improvements are also planned for the Union Pacific Railroad bridge on Lake Wallula to eliminate the existing navigation hazard. Terminal facilities will be improved and expanded in the 1980 to 2000 and the 2000 to 2020 time periods along with additional small-boat moorages.

Lower Columbia River navigation developments in the 1970 to 1980 period include maintenance of the deep draft channel to Portland (included in Area D plan), improvement and expansion of port facilities at Astoria, and expansion of existing and construction of new small-boat moorages on the Oregon side of the river. These activities will continue to 2020.

Navigation plan elements included for the Willamette River during the 1980 to 2000 time period consist of the authorized rebuilding of the Willamette Falls locks and open channel works as a supplement to increased low streamflows to provide increased depths to the Corvallis-Albany area. Associated port and terminal facilities would be required.

Coastal navigation development planned for the 1970 to 1980 time period includes completion of the south jetty at Tillamook, jetty and channel work to improve entrance conditions of the Umpqua River, channel improvements at Coos Bay and Siuslaw River, and improvement of the entrance and channel of the Rogue River. Private developmental efforts would be toward expanding existing and constructing new small-boat basins at most of the coastal ports. Developments during the 1980 to 2000 period include the addition of three small-boat harbors along the coast and expansion of existing small-boat facilities. Additional activities through 2020 would be limited to maintaining channel and jetty developments.

Water Quality Control

Waste Water Treatment This study has assumed that the standards set by the states would be met to the extent that waste treatment would achieve 85 percent organic removal by 1980. New or expanded waste treatment plants with adequate facilities to remove waste loadings to reach a treatment level of 90 percent removal by 2000 and 2020 are included in the plan. Table 81 illustrates the residual wastes projected for the area on the basis of this treatment.

Table 81 - Projected Raw Waste Production and Residual Discharge with Planned Treatment, Area C

	1970		1980		2000		2020	
	Raw	Disch.	Raw	Disch.	Raw	Disch.	Raw	Disch
				(1,000 p.e.)				
Subregion 7								
Municipal	158	28	191	29	272	27	364	36
Industrial	1,509	362	2,031	305	2,672	267	3,472	347
Recreation	76	11	115	16	213	22	392	40
Total	1,743	401	2,337	350	3,157	316	4,228	423
Subregion 9								
Municipal	1,678	234	1,916	287	2,700	270	4,104	410
Industrial	4,506	676	4,142	621	5,955	596	7,652	765
Recreation	170	26	229	35	428	42	801	81
Total	6,354	936	6,287	943	9,083	908	12,557	1,256
Subregion 10S								
Municipal	230	50	277	42	397	40	547	55
Industrial	1,524	930	2,169	325	2,600	260	2,836	284
Recreation	152	23	207	31	374	37	700	69
Total	1,906	1,003	2,653	398	3,371	337	4,083	408
Subregion 12								
Municipal	7	0	9	1	12	1	16	2
Industrial	0	0	0	0	0	0	0	0
Recreation	8	1	11	3	19	2	34	3
Total	15	1	20	4	31	3	50	5
Area C								
Municipal	2,073	312	2,393	359	3,381	338	5,031	503
Industrial	7,539	1,968	8,342	1,251	11,227	1,123	13,960	1,396
Recreation	406	61	562	85	1,034	103	1,927	193
Total	10,018	2,341	11,297	1,695	15,642	1,564	20,918	2,092

Source: Appendix XII, Water Quality and Pollution Control, modified by Type 2 data for Subregion 9.

Water quality aspects of the plan include: (1) improved waste treatment facilities, (2) releases from storage to provide minimum flows as needed for water quality purposes in streams where water quality problems cannot be solved entirely by waste treatment, (3) improved irrigation management (4) legislation to prohibit discharge of wastes from boats and ships, (5) modification

of dredging practices to minimize turbidities and reduce the toxic and oxygen demanding materials, and (6) location of industrial plants on the basis of water resource capabilities of the streams to provide a water supply and to receive and assimilate any treated waste discharges.

The implementation and enforcement plan for the public waters of the State of Oregon requires that all municipalities and industries provide secondary treatment or its equivalent. It planned that all communities or cities would be served by municipal sewage collection systems with secondary waste treatment facilities.

The major industrial waste contributors are the pulp and paper and the food processing industries. Facilities are included for advanced treatments in critical areas to remove salts, residual organic materials, and nutrients. Pulp and paper mills will, as soon as possible, complete the installation of waste treatment facilities, including equipment to condense and burn sulfite waste liquors. Food processing plants will provide separate sewer and secondary treatment in communities whose municipal systems are not adequate.

Limited tests indicate stream contamination from agricultural land runoff and return flow from irrigation is not serious except when silt is also included. Salinity is not a problem except in a few minor streams in the drier areas. The extensive land measures and water conservation programs are planned to maintain or improve the water quality from these sources by reducing erosion, runoff, and return flow.

The animal population represents a potential source of organic wastes. The population equivalent of these wastes is estimated to reach 11.0 million in 1980, 14.7 million in 2000, and 19.2 million in 2020. To prevent the wastes from possibly entering the water courses, construction of fences and simple retaining structures between the animal habitat and watercourses is recommended to prevent bank erosion and to limit direct surface drainage so that wastes may decompose through soil processes. At some places it may be preferable to collect the waste from cattle-holding facilities for treatment or to be distributed to the land as a fertilizer.

Minimum Flows As waste treatment does not provide an economic solution for complete removal of contaminants and cannot be applied to noncollectible wastes, a certain amount of streamflow is necessary for dilution and assimilation of residual wastes reaching the streams. The minimum flow requirement is related to a number of factors, including the strength of deoxygenation

capacity of the wastes, and the temperature, reaeration capacity, elevation, and minimum allowable dissolved oxygen for the stream. Minimum flows instream are required for fisheries and esthetic values. Such flow requirements would probably be sufficient to assimilate any wastes that may reach the streams. Studies to establish minimum flow requirements are included in the listing of required future studies.

Municipal and Industrial Water Supply

Water resources generally are available to meet the demands of municipal, industrial, and rural-domestic water supply. However, local difficulties in obtaining water undoubtedly will develop. As municipal systems are expanded and replaced in the future, communities will have to shift to complete treatment of their raw water surface supplies. Where quality of ground water cannot be controlled, treatment also will be required. The framework plan includes measures for conveyance to the point of distribution and treatment as required to bring the quality of projected water needs to interstate standards. Table 82 shows the projected water supply needs by subregion and time period.

Municipal About 66 percent of the population in Subregion 7 is served by municipal water systems. Local shortages occur at Walla Walla, Dayton, The Dalles, and several communities in the John Day and Klickitat basins. Municipal needs are projected to nearly double by 2020, and 80 percent of the population will obtain water from central systems. No serious water shortage is anticipated. Supplies will be obtained from local ground and surface sources.

About 84 percent of the population of Subregion 9 is served by municipal water systems. By 2020, about 95 percent of the population is expected to be served by central systems. Most water supply problems may be solved by storage, transmission, or treatment; however, small communities are seldom able to finance the improvements. Water treatment practices vary at the present time, but all surface water would be subject to complete purification in the future.

Approximately two-thirds of the population of the Subregion 10S are served by municipal water systems. Approximately 75 percent of the water is supplied from surface sources. The quality and quantity of the water are generally adequate; however, some municipalities have inadequate sources such as small coastal streams, springs, and wells. Several systems do not hold adequate water rights.

About 44 percent of the population of Subregion 12 are served by municipal water systems. Ground water without treatment is utilized by all water systems. By 2020, 77 percent of the population will be utilizing municipal water distribution systems.

Industrial Sufficient quantities of water are available in the area to meet the projected industrial water requirements, and no problems are anticipated. However, there may be isolated situations requiring storage to meet peak demands. Treatment may be required in some instances to meet industrial requirements.

Rural-Domestic Most rural-domestic supplies would be from ground water and no serious quality problems are anticipated; however, treatment will be required if the quality should be below acceptable standards. Except for possible shortages in small localized areas, there is not expected to be a problem in meeting future municipal, industrial, and rural-domestic diversion requirements.

Flood Control

Damages from flooding on both major and minor streams are projected to increase from the present level of $19,479,000 annually to $67,074,000 by 2020 under present levels of protection. Structural measures and land treatment would reduce the extent and frequency of flooding. Nonstructural measures, except land treatment measures, would reduce the impact of floods without controlling the flood waters. This combination of structural and nonstructural measures is usually referred to as flood plain management.

Nonstructural Measures Although structural measures are usually considered the best method of reducing flood damage potential, many areas exist where full or even partial structural flood control is either undesirable or not feasible. For this reason the plan also provides for the nonstructural aspects of a flood plain management program.

Flood plain regulations, i.e., land use zoning, subdivision regulations, building codes, etc., should be enacted for the entire area. Even in areas having no flood problems or areas protected by structural measures, encroachment into the stream channel can cause upstream flooding. The plan indicates that regulations would be of particular benefit at the flood prone locations listed in the following tabulation.

Table 82 - Planned Municipal and Industrial Water Supply, Area C

Sub-region	Water Use	1970	1980	2000	2020
			(mgd)		
7	Municipal	42.9	51.0	75.1	96.6
	Walla Walla Service Area	(10.4)	(10.9)	(16.7)	(22.9)
	Pendleton Service Area	(4.5)	(6.4)	(8.2)	(9.6)
	Bend Service Area	(3.9)	(5.0)	(7.2)	(9.7)
	The Dalles Service Area	(3.3)	(4.2)	(6.2)	(8.9)
	Other	(20.8)	(24.5)	(36.8)	(45.5)
	Industrial	74.8	96.7	113.6	139.2
	Rural-Domestic	18.3	22.4	29.3	37.4
	Total	136.0	170.1	218.0	273.2
9	Municipal	233.5	361.1	562.8	920.1
	Eugene-Springfield Service Area	(28.2)	(42.3)	(67.0)	(105.3)
	Albany-Corvallis Service Area	(13.6)	(22.4)	(34.6)	(52.9)
	Salem Service Area	(24.8)	(36.5)	(55.1)	(81.2)
	Portland Service Area	(149.5)	(218.7)	(345.1)	(586.7)
	Other	(17.4)	(41.2)	(61.0)	(94.0)
	Industrial	199.2	230.6	332.2	483.8
	Rural-Domestic	18.5	23.1	29.7	36.9
	Total	451.2	614.8	924.7	1,440.8
10S	Municipal	37.5	48.0	74.9	109.2
	Medford Service Area	(9.4)	(12.4)	(24.3)	(41.5)
	Coos Bay Service Area	(4.7)	(6.6)	(11.8)	(20.8)
	Astoria Service Area	(3.1)	(4.2)	(6.3)	(9.6)
	Other	(20.3)	(24.8)	(32.5)	(37.3)
	Industrial	156.7	225.1	288.9	315.7
	Rural-Domestic	12.6	15.1	18.0	19.9
	Total	206.8	288.2	381.8	444.8
12	Municipal	1.8	2.5	3.7	5.1
	Industrial	1.5	1.6	1.6	1.7
	Rural-Domestic	3.9	4.4	5.6	6.9
	Total	7.2	8.5	10.9	13.7
Area C					
	Municipal	315.7	462.6	716.5	1,131.0
	Industrial	432.2	554.0	736.3	940.4
	Rural-Domestic	53.3	65.0	82.6	101.1
	Total	801.2	1,081.6	1,535.4	2,172.5

Source: Appendix XI, Municipal & Industrial Water Supply.

Touchet River	Waitsburg area
Umatilla River	Pendleton area
Tutuilla and McKay Creeks	Pendleton area
Canyon Creek	Canyon City to John Day, Oregon
Zintel Canyon	Kennewick, Washington, area
Willamette River	Springfield to Portland, Oregon
McKenzie River	Leaburg to confluence with Willamette River
Middle Fork Willamette River	Jasper to Springfield
Coast Fork Willamette River	Vicinity of Cottage Grove to Springfield
Little Klickitat River	Vicinity of Goldendale
Rogue River	Vicinity of Grants Pass
Coquille River	Vicinity of Coquille
Wilson, Trask, & Tillamook Rivers	Vicinity of Tillamook
Chewaucan River	Vicinity of Paisley
Silvies River	Burns to Malheur Lake
Umpqua & South Umpqua River	Roseburg area
Umpqua River	Reedsport area
Smaller Coastal Streams	
Willamette River tribs.	

Flood plain regulations can have little effect on damages to structures presently occupying the flood plain. However, zoning could insure that the flood problem is not aggravated by further developments and could eventually reduce damages by the abandonment of some existing structures on the flood plain as they reach replacement age. Accordingly, the plan encourages all flood prone communities in the area to qualify for flood insurance through the National Flood Insurance Program. In addition, flood proofing would be accomplished at a number of locations to protect existing development where flood control works are not warranted or desired at this time. The ongoing Federal-State programs of flood forecasting and evaluation also will be continued.

Although information as to the extent of and damages caused by flooding is needed to determine structural solutions, the data demands for nonstructural alternatives are much more pressing. The plan recommends that flood plain information studies by carried out within the 1970-1980 time period for all flood prone areas. Areas of particular urgency are indicated in the following tabulation.

Umatilla River	Downstream from Pendleton
Willow Creek	Near Heppner
Fifteenmile Creek	Near The Dalles
John Day River	Dayville to John Day
North Fork John Day River	Near Monument
Silves River	Near Burns
Ochoco Creek	Prineville to Ochoco Reservoir

Squaw Creek	Near Sisters
Coastal Streams	Various locations
Willamette River tribs.	Various locations
Columbia River	St. Helens to mouth

Although planned structural control might completely alleviate the flood problem in some of these areas, flood plain information would still be necessary for use in the implementation of interim nonstructural measures. This is particularly true for those structural measures scheduled for the 2000-2020 time period.

Structural Measures With the exception of the Zintel Canyon Project, no major single-purpose flood control storage is planned for this area; however, the multiple-purpose storage described under "Reservoir Storage" would be operated for flood control. A total of 445 miles of levees and channel works listed in the following table are included in the plan. These local protection works supplement the protection afforded by storage where it exists.

The local protection works in table 83 are single-purpose flood control measures and generally would provide a minimum protection against floods of 100-year frequency in urban areas and 25-year frequency in rural areas. A higher degree of protection would be provided where justified.

In addition to the above improvements, flooding would also be alleviated on many tributary watersheds by land treatment measures and small ponds or reservoirs. These measures and practices are given in the "Related Land Programs" section.

Table 83 - Planned Local Flood Protective Works, Area C

Stream & Location	Miles	Type of Work
	1970-1980	
Zintel Canyon at Kennewick, Washington	2	Channel work
Willow Creek at Heppner, Ore.	2	Channel work
Elk Creek near Cannon Beach	1	Levees
Willamette River and major reservoir-controlled tributaries	47	Channel stabilization and Closures
Sandy and Clackamas Rivers	5	Channel stabilization
	1980-2000	
Walla Walla River downstream from Milton-Freewater	10	Levees and channel work
Touchet River at Waitsburg, Washington	6	Levees and channel work
Umatilla River downstream from Echo and above Pendleton, Oregon	5	Levees and channel work
John Day River downstream from Mt. Vernon, Oregon	8	Levees and channel work
Willamette River and major reservoir-controlled tributaries	40	Channel stabilization
Tualatin River and tributaries	63	Channel work
Pudding River downstream from Abiqua Creek	46	Channel work
Rogue River at Grants Pass	5	Levees
Umpqua River	24	Levees
Coquille River at Coquille	2	Levees
Nestucca River	30	Levees
Streams in Tillamook Bay area	47	Levees
Nehalem River	10	Levees
	2000-2020	
Dry Creek near Lowden	8	Levee and channel work
Tributaries to Umatilla River at Helix, Athena, Pilot Rock, and Stanfield	5	Levee and channel work
John Day River at Dayville, John Day, and Prairie City and Canyon Creek at Canyon City	4	Levee and channel work
Willamette River and major reservoir-controlled tributaries	20	Channel stabilization
Yamhill River	55	Channel work

Irrigation

The plan provides for irrigation of 1,558,000 acres in the next 50 years, bringing the total to 2,850,000 irrigated acres by 2020. Included are 37,000 acres beyond the needs to offset the production deficiency created by not providing supplemental water to all inadequately irrigated lands. The determination of additional new land acreage is based on relative diversion requirements of supplemental and full service lands such that total water requirements are the same as if all supplemental lands were served. In total, the plan provides supplemental water supplies to 477,000 acres of the 602,000 acres of land inadequately supplied. The remainder of the lands are located too distant from available water supplies to be economically served.

Irrigation diversions shown in table 84 indicate an increase of about 5.5 million acre-feet is required for new and supplemental service lands included in the plan by 2020. About 0.7 million acre-feet are planned to be pumped from ground-water supplies, and the remaining 4.8 million acre-feet are to be supplied from surface sources, primarily from new storage reservoirs.

Approximately 21 percent of the irrigation development is expected to be through private initiative, both individually and by small groups, and the remainder through Federal and federally assisted projects. Most of the private development is anticipated in the Willamette Basin where ground-water supplies are more abundant.

In Subregion 7, Mid Columbia, irrigation development would be primarily by major Federal and federally assisted projects in the Umatilla, Deschutes, Walla Walla, and White Salmon River Basins and along both sides of the Columbia River. Water supplies for these projects would be provided from storage and from Columbia River streamflow. Some private development is anticipated adjacent to Columbia River by river pumping and at other locations in the subregion wherever ground-water supplies are available or farm pond construction is practical. Supplemental water supplies could not be provided to 14,000 acres of inadequately irrigated lands in the John Day Basin; consequently, the plan includes irrigation of 1,800 acres of new lands additional to subregion projections. More than 5 million acres of potentially irrigable lands remain beyond the development included in the plan.

In Subregion 9, Willamette, irrigation would be a mixture of private, Federal, and federally assisted developments. More than two-thirds of the water for the new irrigation would be supplied from existing and new reservoirs on about an equal basis, with the remainder coming from ground water, farm ponds,

Table 84 - Planned Irrigation Development, Diversions, and Depletions, Area C

Location or Basin	1970-1980 Acreage New (1,000 ac)	1970-1980 Acreage Suppl. (1,000 ac)	1970-1980 Diversion (1,000 ac-ft)	1970-1980 Depletion (1,000 ac-ft)	1980-2000 Acreage New (1,000 ac)	1980-2000 Acreage Suppl. (1,000 ac)	1980-2000 Diversion (1,000 ac-ft)	1980-2000 Depletion (1,000 ac-ft)	2000-2020 Acreage New (1,000 ac)	2000-2020 Acreage Suppl. (1,000 ac)	2000-2020 Diversion (1,000 ac-ft)	2000-2020 Depletion (1,000 ac-ft)	1970-2020 Acreage New (1,000 ac)	1970-2020 Acreage Suppl. (1,000 ac)	1970-2020 Diversion (1,000 ac-ft)	1970-2020 Depletion (1,000 ac-ft)
Subregion 7																
Hood	10	6	-	-	1	0	-	-	3	0	-	-	14	6	-	-
Deschutes	14	3	-	-	19	110	-	-	74	0	-	-	107	113	-	-
John Day	11	12	-	-	11	16	-	-	3	11	-	-	25	39	-	-
Umatilla	131	23	-	-	2	2	-	-	74	3	-	-	207	28	-	-
Walla Walla	66	51	-	-	17	0	-	-	10	0	-	-	93	51	-	-
Northside	75	0	-	-	40	0	-	-	108	0	-	-	223	0	-	-
Total	307	95	1,537	827	90	128	410	200	272	14	1,006	599	669	237	2,953	1,626
Subregion 9 Total	186	26	589	325	420	0	1,034	657	150	0	268	213	756	26	1,891	1,195
Subregion 10-S																
Rogue	32	8	-	-	0	0	-	-	7	2	-	-	39	10	-	-
Umpqua	23	1	-	-	1	0	-	-	4	6	-	-	28	7	-	-
Coastal	11	1	-	-	3	0	-	-	11	0	-	-	25	1	-	-
Total	66	10	244	140	4	0	8	5	22	8	72	47	92	18	324	192
Subregion 12																
Ft. Rock	7	14	-	-	20	20	-	-	0	0	-	-	27	34	-	-
Silvies	0	55	-	-	0	62	-	-	0	0	-	-	0	117	-	-
Alvord	0	8	-	-	14	37	-	-	0	0	-	-	14	45	-	-
Total	7	77	116	71	34	119	256	154	0	0	0	0	41	196	372	225
Area C	566	208	2,486	1,363	548	247	1,708	1,016	444	22	1,346	859	1,558	477	5,540	3,238

and natural flows. With only minor exceptions, new storage is proposed to irrigate only those lands which cannot be supplied economically from existing and authorized reservoirs. About 370,000 acres of potentially irrigable land would remain in the basin after needs have been met in 2020.

In Subregion 10S, coastal part of Oregon, future irrigation would rely almost entirely on storage of streamflow for its water supply, because existing streamflows are already appropriated during the irrigation season and ground-water supplies are limited. About 41 percent of the new irrigation is planned in the Rogue Basin with the Umpqua and Coastal Basins accounting for the remaining 32 and 27 percent, respectively. Supplemental water supplies could not be provided to about 29,000 acres in this subregion; consequently, the plan includes irrigation of about 7,000 acres of new lands additional to subregion projections. More than 700,000 acres of potentially irrigable lands would remain in the subregion after meeting the needs in 2020.

In Subregion 12, the Oregon Closed Basin, future irrigation development of new lands by private and federally assisted projects is planned in the western and southeastern portion of the subregion. Also, a major portion of its inadequately irrigated lands would be provided a supplemental water supply. Water supplies for new and supplemental lands are planned to be provided from ground water and storage of streamflows at a ratio of about two-thirds and one-third, respectively. In the Silvies River Basin, future irrigation water supplies would be drawn primarily from ground water to lessen the possible adverse impact on Malheur Lake. Supplemental water supplies could not be provided to about 82,000 acres; consequently, the plan includes irrigation of about 28,000 acres of new lands additional to subregion projections. Almost 3 million acres of potentially irrigable lands would remain in the basin after the irrigation plan has been put into effect.

Reservoir Storage

Reservoir storage included in the framework plan for the next 50 years totals nearly 6.5 million acre-feet. In most cases the storage would serve the purposes of: (1) providing a water supply for irrigation, (2) controlling floods, (3) providing water supplies for cities, and (4) furnishing a water body for general recreation and fishing. In specialized cases, the storage would be used for generating electric power and increasing streamflows for the purpose of improving water quality and providing sufficient depths for navigation. A summary of the proposed storage is shown in table 85 by river basin and time periods.

Table 85 - Planned Reservoir Storage, Area C

	Increments of Storage				
	1980	2000	2020	Total	Purpose[1/]
		(1,000 ac-ft)			
Subregion 7					
Hood	58	-	5	63	F, FC, I, M, R
Deschutes	32	408	106	546	F, FC, I, M, R
John Day	40	94	19	153	F, FC, I, M, R
Umatilla	468	-	-	468	F, FC, I, M, R
Walla Walla	260	-	81	341	F, FC, I, M, R, WQ
Northside Columbia	106	-	61	167	F, FC, I, M, R
Columbia River	-	-	-	-	F, FC, I, M, R
Total	964	502	272	1,738	
Subregion 9	933	1,282	701	2,916	F, FC, I, M, N, P, R, WQ
Subregion 10S					
Rogue	738	3	-	741	F, FC, I, M, P, R
Umpqua	103	625	7	735	F, FC, I, M, R
Coastal	17	175	22	214	F, FC, I, M, R
Total	858	803	29	1,690	
Subregion 12					
Ft. Rock, Christmas L. & Chawaucan	14	37	-	51	F, FC, I, M, R
Silvies R., Silver Cr., Donner und Blitzen	-	9	-	9	F, FC, I, R
Alvord, Catlow & Warner Lakes	-	65	-	65	F, FC, I, R
Total	14	111	-	125	
Area C	2,769	2,698	1,002	6,469	

1/ F-Fish; FC-Flood Control; I-Irrigation; M-Municipal-Industrial; N-Navigation; P-Power; R-Recreation; WQ-Water Quality Control.

In the Mid Columbia Subregion, 57 reservoirs with capacities ranging up to 200,000 acre-feet would provide the planned storage. Most of the storage would be in the Deschutes, Umatilla, and Walla Walla River Basins. In the Deschutes River Basin, reservoirs are planned primarily to provide attractive water bodies for recreation and fishing and to allow a moderate expansion of irrigation without reducing streamflows during the low flow season. In the Umatilla and Walla Walla River Basins, future irrigation and flood control needs are more critical; consequently, a greater percentage of the storage would be for these purposes than in the Deschutes Basin. Water quality control is also an important purpose of Walla Walla Basin storage, because even with projected improvements in waste treatment, flow augmentation is necessary during critical periods. The John Day River Basin has great potential for anadromous fish production; consequently, a major purpose of storage in that basin is to improve low streamflows for the enhancement of anadromous fish runs. In the Hood and Northside Columbia Basins, storage is planned primarily for irrigation with benefits accuring to most other functions as well.

The Willamette portion of the plan includes almost 3 million acre-feet of storage in 93 new storage reservoirs plus modification of one existing reservoir and enlargement of one authorized reservoir. The projects range in size from 1,000 acre-feet to more than 270,000 acre-feet. The new projects would generally be located in the western and northern portions of the subregion, because previous reservoir construction has met the majority of needs in the southern and eastern portions. Reservoir projects would be multiple-purpose in scope, typically providing flood protection and water for irrigation, recreation, and fish. In particular situations, the storage would also be used for municipal and industrial water supply, water quality control, navigation, and electric power production.

In Subregion 10S the plan includes about 1.7 million acre-feet of storage in 19 new reservoirs which range in size from 200 acre-feet to 550,000 acre-feet. The two largest reservoirs would be located on the Rogue and South Umpqua Rivers with the remainder of the storage in small to medium-sized reservoirs scattered over the subregion. Flood control would be a major function of most of the reservoirs as previous construction of reservoirs has been limited and most streams are essentially uncontrolled. Other typical uses of the storage would be for municipal, industrial, and irrigation water supply, water quality control, general recreation, and fish production. In the Rogue River Basin, the storage would also be used for electric power production.

The plan includes only 125,000 acre-feet of storage in the Oregon Closed Basin, Subregion 12. The storage would be contained in 11 relatively small multiple-purpose reservoirs, all of which would be constructed prior to 2000. In the interest of maintaining Malheur Lake in its present state, no storage is planned on the Silvies River. However, 9,300 acre-feet are planned on tributaries of Silver Creek which drains into Harney Lake and could affect the management of the Malheur National Wildlife Refuge.

Preservation and Enhancement of Natural Environment

Preservation of Rivers About 85 miles of the lower Rogue have been included in the national wild and scenic rivers system. Both the Rogue River, from its confluence with the Applegate River downstream 88 miles to Lobster Creek Bridge, and the Illinois River, from Deer Creek downstream 46 miles to its confluence with the Rogue, are designated scenic rivers under the State of Oregon's scenic waterways system. Rivers designated by Congress for study under Section 5(d) of the Wild and Scenic Rivers Act are listed in table 86. It also lists other streams or stream segments which are recommended for study to determine whether they should be a part of a national or state system of recreation streams.

Table 86 - Potential Recreation Streams, Area C

Description	Miles	Acres at 320/mile
Subregion 7		
Rivers designated for study in the Wild and Scenic Rivers Act, P.L. 90-542 Sec. 5(d)		
Deschutes - from Pelton Reregulating Dam to confluence with the Columbia River1/	100	32,000
John Day - mouth to confluence with North Fork (Kimberly)1/	185	59,200
North Fork John Day - from Kimberly to junction with Baldy Creek1/	106	33,920
Granite Creek - mouth to junction with Clear Creek	7	2,240
Other Rivers Selected for Study		
Klickitat River - from Indian reservation boundary to confluence with Columbia River2/	84	26,880
John Day River - from Kimberly to Dayville1/	27	8,640
North Fork John Day River - origin to junction with Baldy Creek1/	6	1,920
Deschutes River - free-flowing segments from origin to Pelton Reregulating Reservoir1/	120	38,400
Crooked River - from Prineville Reservoir to Lake Billy Chinook1/	65	20,800
Little Deschutes River - from Mowich to confluence with Deschutes River1/	80	25,600
Metolius - from Camp Sherman to Billy Chinook Lake1/	27	8,640
White Salmon River - All except project facilities2/	38	12,160
Wind River - origin to mouth1/	29	9,280
Total Section 5(d)	398	127,360
Total Other Rivers	476	152,320
Subregion 7	874 3/	279,680 3/

1/ All or a portion of this stream is recommended to be considered for fish habitat preservation.
2/ Extent of planned projects is not known at this time.
3/ Impoundments not included.

Table 86 - Continued

Stream	Exceptions 1/
	Subregion 9
Willamette River 2/	Existing projects, navigation, and flood control channel modifications.
Tualatin River 2/	Gaston Reservoir, Tualatin channel.
Clackamas River 2/	Existing projects, Big Bottom Reservoir, local flood control under Sec. 205.
Eagle Creek	Eagle Creek Reservoir.
Collawash	None.
Mt. Hood Wilderness and Recreation area	None.
Yamhill River 2/	None.
Rickreall Creek	Dallas Reservoir.
Marys River 2/	Noon Reservoir.
Molalla River	Dickey Bridge Reservoir, channel modifications.
Butte Creek	None.
Abiqua Creek	None.
Santiam River 2/	Existing projects, channel modifications.
North Santiam River 2/	Existing projects, channel modifications.
Little North Santiam River 2/	Lyons Reservoir.
Breitenbush River	None.
South Santiam River 2/	Existing and authorized projects, channel modification.
McDowell Creek	None.
Wiley Creek	Upper Wiley Creek Reservoir.
Middle Santiam River	Existing projects.
Calapooia River	Authorized Holley Reservoir, including downstream channel.
Mt. Jefferson Wilderness Streams	None.
Long Tom	None.
McKenzie 2/	Existing projects, channel modifications.
White Branch Creek	None.
Horse Creek	None.
French Pete Creek	None.
South Fork McKenzie River	Existing and authorized projects.
Mt. Washington, Three Sisters Wilderness streams	None.
Coast Fork, Willamette 2/	Existing projects, channel modifications.
Mosby Creek	Abrams Reservoir.
Middle Fork, Willamette 2/	Existing projects, channel modifications.
North Fork, Middle Fork	None.
Diamond Peak Wilderness streams	None.
Waldo Lake Recreation Area streams	None.
Sandy River, Columbia Gorge Recreation area	None.

Subregion 9, Total Miles, 1,250 3/
Subregion 9, Total Acres, 400,000 3/

1/ Entire stream recommended for preservation with the following exceptions.
2/ See footnote 1, page 426.
3/ Impoundments not included.

Table 86 - Continued

Description	Miles	Acres at 320/mile
Subregion 10S		
Components of the National Wild and Scenic Rivers System, P. L. 90-542		
Rogue River - a segment of river from its junction with Applegate downstream to Lobster Creek Bridge1/	85	27,2000
Rivers designated for study in the Wild and Scenic Rivers Act, P.L. 90-542 Sec. 5(a)		
Illinois River - all1/	75	24,000
Other Rivers Selected for Study		
Nehalem River - all except project facilities1/	114	36,480
Miami River - origin to mouth2/	12	3,840
Kilchis River - from the junction of the North and South Forks to mouth2/	14	4,480
North Fork, Kilchis River - from origin to the confluence with the South Fork2/	6	1,920
Wilson River - from origin to mouth2/	42	13,440
Trask River - origin to mouth2/	18	5,760
North Fork - from origin to Junction with the South Fork2/	13	4,160
Nestucca River - from origin to mouth2/	50	16,000
Little Nestucca River - from origin to mouth2/	18	5,760
Salmon River - origin to mouth2/	16	5,120
Siletz River - origin to mouth (includes North Fork)2/	74	23,680
Alsea River - from town of Alsea to its mouth2/	49	15,680
Siuslaw River - from confluence with Lake Creek to mouth2/	29	9,280
Lake Creek - from Triangle Lake to confluence with Siuslaw River2/	19	6,080
Smith River - from junction with the South Fork to its mouth2/	58	18,560
Rogue River - from Lost Creek Dam to Gold Ray Reservoir2/	33	10,560
Segment from Savage Rapid Dam to confluence with Applegate River2/	13	4,160

1/ See footnote 1, page 426.
2/ Extent of planned projects is not known at this time.

Table 86 - Continued

Description	Miles	Acres at 320/mile
Umpqua River - from junction with the North Umpqua and South Umpqua Rivers to mouth1/	87	27,840
North Umpqua River - from Lemolo Dam to confluence with South Umpqua River1/	83	26,560
Sixes River - main stem, origin to mouth1/	28	8,960
Chetco River - origin to mouth1/	55	17,600
Elk River - origin to mouth1/	30	9,600
Applegate River - all in Oregon except project facilities1/	51	16,320
Total Federal Designated Rivers	85	27,200
Total Federal Study Rivers Section 5(a)	75	24,000
Total Other Rivers	912	291,840
Subregion 10S	1,072	343,040
Subregion 12		
None		
Area C	3,196 2/	1,022,720 2/

1/ See footnote 1, page 426.
2/ Impoundments not included.
Source: Appendix XIII, Recreation and comprehensive study of Willamette River Basin (Subregion 9).

Minimum Flows for Environmental Values Minimum flows for fish and water quality are closely related to minimum flows for environmental values. These flows determine the attractiveness of the stream, whether it be for fish, sanitary reasons, or human enjoyment.

A study of all streams would be desirable to establish a basis on which to judge the need for augmentation of flows or for control of development which either withdraws water from the stream or changes its flow pattern.

Estuaries rely on particular streamflow characteristics for their productiveness and one of these characteristics is stream discharge. The framework plan for the coastal portion of the area expresses the need for considerably more hydrologic, hydraulic, biologic, and water quality data before flows for optimum estuarine production and preservation of existing environmental conditions can be determined.

Landscape Management and Control Landscape management and control measures and programs should be continued to protect the lands adjacent to scenic roads; wild, scenic, and recreational rivers; areas around reservoirs, natural lakes, beaches, estuaries, and wildlife refuges; and to create buffer zones around recreational areas. Locations of future highways, powerplants, and accompanying transmission facilities should blend with the natural landscape. Future development in general must be such that it will minimize adverse environmental effects and preserve the scenic, historic, and cultural values which constitute the unique values of the area. The acreage required to satisfy this element has not been determined. Public ownership is not necessary for all lands, as the objective of this program is to provide a natural background setting to add to the enjoyment of the recreation visitors.

Wilderness and Primitive Areas Numerous wilderness and primitive features exist within the area, and acreages adjacent to these features have been set aside for leisure, recreation, and scientific study. Of particular interest are the John Day Fossil Beds, six wilderness areas in the Cascade Range, the Oregon Caves, Kalmiopsis Wilderness, Malheur National Wildlife Refuge, and the Hart Mountain National Antelope Refuge. Use of these areas will continue to increase; however, it is difficult to determine the actual needs. The framework plan suggests that these wilderness and primitive areas be studied to determine future needs, level of human use, and, specifically, a study to determine the effect of surface and ground-water withdrawals on the operation of the Malheur National Wildlife Refuge.

Historic and Unique Areas A number of historically significant localities exist, including both the Lewis and Clark and the Oregon Immigrant Trails. Other features are: Fort Lee, Fort Dalles Military Reservation, The Dalles-Canyon City Military Wagon Road, Stonehenge Replica, the now-submerged Celilo Falls (Indian fishing grounds), Fort Yamhill, Willamette Military Road, and numerous missionary sites and "century" farms.

The two features of greatest historical significance along the Oregon coast, both in the Astoria area, are the Fort Clatsop National Memorial, where Lewis and Clark wintered in 1804-05, and the Astor Column, commemorating the fur trade period. The re-creation of old Jacksonville, near Medford, recalls the southern Oregon gold rush of 1856. In southeastern Oregon, around the turn of the century, huge cattle empires were established and homesteading was attempted. Some of these ventures failed, leaving the abandoned building remains to become interesting tourist attractions.

To aid in meeting future recreation needs, the above mentioned attractions and other appropriate areas should be studied and a plan prepared for their preservation and future management to accommodate the increased recreation pressures. Consideration should be given to using more informative programs, such as guides, at these historical areas.

Fish and Wildlife

The framework plan contains measures to maintain or improve the existing fish and wildlife base and, insofar as possible, to meet the projected fishing and hunting needs. Major elements of the plan for fish and wildlife are shown in table 77.

Fish The fish resource is of major economic and recreational importance. Major groups of fish existing in the area are anadromous and resident game fish (salmonid and nonsalmonid), marine fish, shellfish, and nongame fish.

Streams and other fish habitat areas were analyzed for their potential. The framework plan recommends that the streams listed in table 87 be considered for preservation and protection as fish habitat. These streams and/or segments should be considered for retention in a natural free-flowing state to preserve their special habitats and to retain the quality angling they now provide. The physical character of these streams (bottom materials, meandering course, and bank vegetation), along with the present flows and acceptable water quality, would be retained and not allowed to deteriorate. Fish habitat preservation and improvement measures necessary to meet projected fishing needs are discussed further in Appendix XIV.

Table 87 - Preservation of Fish Habitat, Area C

Stream or Water Body	Reach
Subregion 7	
Rock Creek (Washington)	All
Deschutes River1/	Free-flowing portions from origin to Columbia River
Little Deschutes River1/	From Mowich to Deschutes River
Metolius River1/	Origin to Billy Chinook Lake
Quinn River	All
Klickitat River1/	All below Indian Reservation
Big White Salmon River	Free-flowing segments
Crooked River1/	Prineville Dam to Billy Chinook Lake
Wind River1/	All
John Day River1/	Town of Dayville to Lake Umatilla
North Fork John Day River1/	All
Walla Walla River	Free-flowing segments
Subregion 9	
Sandy River	Mt. Hood Wilderness boundary to Columbia River
Willamette River1/	All
Tualatin River1/	Downstream from Scoggins Creek
Clackamas River1/	Oak Grove Fork to Willamette River
Yamhill River1/	Lower 5 miles
Santiam River1/	All
North Santiam River1/	Big Cliff Dam to South Santiam River
Little North Santiam River1/	Elkhorn to North Santiam River
South Santiam River1/	Foster Dam to North Santiam River
Pudding River	Lower 2 miles
Marys River1/	Lower 5 miles
McKenzie River1/	All
Middle Fork Willamette1/	Downstream from Dexter Dam
Coast Fork Willamette1/	Downstream from Cottage Grove Dam

1/ All or portions of these streams are recommended for study as potential recreation streams.

Table 87 - Continued

Stream or Water Body	Reach
Subregion 10S	
The free-flowing segments of the following streams and all of the estuaries and lakes listed should be considered:	
Rogue River below planned dam 1/ and estuary	
Coquille River and estuary	
Coos River and estuary	
Umpqua River 1/ and estuary	
Siuslaw River 1/ and estuary	
Alsea River 1/ and estuary	
Siletz River 1/ and estuary	
Salmon River 1/ and estuary	
Nestucca and Little Nestucca Rivers 1/ and estuary	
Sand Lake	
Netarts Bay	
Tillamook Bay and tributary rivers 1/	
Nehalem River and estuary	
Youngs Bay and tributary rivers	
Columbia River and estuary	
The free-flowing segments of all other major stream systems should also be considered.	
Subregion 12	
Donner und Blitzen River System	Origin to Frenchglen
Silvies River System	Origin to vicinity of Burns
Chewaucan River	Free-flowing segments
Silver Creek (Harney County)	Free-flowing segments
Poison Creek	All
Riddle Creek	All
Deep Creek	All
Twelve-Mile Creek	All
Honey Creek	All
Trout Creek	All

1/ See footnote 1, page

Low streamflow is usually the primary factor in determining the adequacy of fish habitat. The State of Oregon has determined minimum flows for fish for most principal streams and their tributaries. Additionally, preliminary optimum flows have been determined. Both the minimum and the optimum flows are in the process of being refined. It is significant to note that in Oregon legal withdrawals can be made and minimum flows established for fish life which is legally recognized as a beneficial use.

Excellent potential exists for increasing anadromous fish runs. In the Umatilla Basin this would require improved passage at existing diversions and low flow augmentation. In the John Day Basin, rearing of anadromous fish is frequently limited by low flows during part of the rearing period. Passage at the White River Falls in the Deschutes River Basin would provide a large additional area for steelhead trout spawning. In numerous other instances, as discussed in the Fish and Wildlife Appendix, passage at both manmade and natural obstacles would expand spawning habitat.

Additional stream and lake access provided for by the framework plan would increase opportunities for utilization of the fish resource. Over 2,100 miles of stream access would be added during the three time periods, and over 400 additional lake access points would be provided.

A significant potential also exists with warm water fish. Present populations could support a substantial increase in use with little or no increase in the present level of management.

Increased fish production would be accomplished through new hatcheries and small rearing ponds. Forty new fish hatcheries and 4,800 acres of rearing ponds are included in the plan.

Wildlife The framework plan provides for satisfying the wildlife needs as detailed in the Fish and Wildlife Appendix. In summary, these measures provide for the improvement of habitat on 1,563,000 acres, improved hunting access to 18,126,000 acres, and the annual production of 49,000 game birds on game farms. The plan also provides for retention of wildlife habitat through acquisition of 665,000 acres of land.

Included in the framework plan is a recommendation for a special hydrologic study of the Malheur Lake area. This study should be initiated as soon as possible to determine the surface-ground water relationship, the effect of withdrawals upon the natural marsh in Malheur Lake and the wildlife production of the Malheur National Wildlife Refuge, and, lastly, water necessary for optimum wildlife production and enhancement without degradation of the marsh environment.

Table 88 shows some of the significant water and land requirements associated with fish and wildlife plan elements.

Table 88 - Fish & Wildlife Plan, Land and Water Requirements, Area C

Item	Units	1970	1980	2000	2020
Fish hatchery water withdrawals	1,000 ac-ft	1,119	1,401	1,621	2,226
Water withdrawals for wildlife areas 1/	1,000 ac-ft	131	201	269	323
Fish & wildlife water areas 2/	1,000 ac	528	534	544	552
Wildlife land use 3/	1,000 ac	46,726	46,433	46,120	45,830
Controlled wildlife land use 4/	1,000 ac	560	794	1,032	1,225

1/ Includes water developments, and access primarily developed for waterfowl enhancement.
2/ Includes small critical fishing waters (less than 500 acres each) and high quality waterfowl habitat.
3/ Most land area is used in varying degrees by wildlife.
4/ Lands operated or owned and managed by fish and wildlife agencies specifically for wildlife control and enhancement.

Outdoor Recreation

The Middle Columbia, Willamette, Closed Basin, and Coastal Subregions offer a wide selection of recreational attractions for recreationists from all parts of the country because of the great variation in elevations, landscape patterns, and ecological systems. The major use is in the summer vacation season with the coastal and large inland water bodies receiving the most attention; however, winter activities are increasing in scope and popularity.

The plan includes water-related recreation facilities to provide an additional 114.0 million recreation days of use between 1970 and 2020. Planned facility and land and water surface requirements for recreation are shown by time periods on table 77, Framework Plan Composition. Additional camping and picnicking facilities are needed near all urban centers, and overnight camping facilities need expansion. Some of the important locations are: Dorena, Cougar, Green Peter, Detroit, Crane Prairie, and Wickiup Reservoirs; Odell, Crescent, and Waldo Lakes; and Tillamook, Haquina, Siletz, Alsea, Siuslaw, and Coos Bays; and along scenic streams and mountain areas including the John Day, Lower Deschutes, Willamette, McKenzie, Santiam, Clackamas, Sandy, Smith, North Umpqua, and South Umpqua River drainages. Development sites (BOR Class I and II areas) are planned on an additional 81,400 acres, mostly adjacent to present high-use areas. About 13,800 acres would be private development, 53,200 acres on State and local governmental lands, and 14,400 acres in Federal areas.

Considering present recreational use, potential use, and future recreational demands of land under various levels of government or in private ownership, most areas have adjacent lands available to meet demands. However, counties and municipalities must acquire an estimated 19,400 acres of urban land and the state must acquire 18,900 acres to meet the need.

Boating activity is rapidly increasing from the 1970 level of 107,000 boats and is projected to reach 584,000 by 2020. The large amount of available water surface stimulates this type of recreation. The framework plan includes development of 3,352 boat launching lanes by 2020 and other related facilities required to meet needs. Table 89 shows boating activity projections.

Table 89 - Planned Elements, Recreation Boating, Area C

Sub-region	Pleasure Craft 1970	Pleasure Craft 1970-2020	Pleasure Craft Total	Launching Lanes 1970	Launching Lanes 1970-2020	Launching Lanes Total	Land Requirements 1970	Land Requirements 1970-2020	Land Requirements Total
		(1,000)			(each)			(acres)	
7	12	36	48	85	265	350	180	590	770
9	76	363	439	532	2,542	3,074	1,063	5,076	6,139
10S	18	76	94	135	525	660	332	2,490	2,822
12	1	2	3	5	20	25	11 1/	44	55 1/
Area C	107	477	584	757	3,352	4,109	1,586	8,200	9,786

1/ Estimated
Source: Appendix XIII, Recreation.

Based on design capacity or the various water related recreation activities, about 357,200 acres of surface water use will be required by 2020 compared to needs of 79,100 in 1970. This additional use will be accompanied by adjacent land facility development and added water access provided in the plan. The area has sufficient water area to meet the projected water surface needs; however, the distribution will pose some problems when the use surpasses the resource capacity near major urban centers. The large reservoirs in the Columbia River have a comparatively small use at the present time and could absorb much of the need in the northern section upriver from Portland.

The study of thousands of miles of free-flowing streams for preservation is a vital part of the framework plan. Certain streams and stream systems have already been officially designated as wild, scenic, or recreation rivers. A list of streams that should be studied for possible preservation as free-flowing streams for recreation and other purposes appears in table 86.

Scenic easements, the construction of viewpoints, and the removal of unsightly structures, including billboards, along highways having an outstanding view of streams and their backgrounds of forests and mountains should be undertaken along certain streams. The highways that should be studied for designation and management as scenic roads are delineated in Appendix XIII, Recreation.

Related Land Programs

The plan includes a wide range of conservation measures and practices designed to reduce erosion and sedimentation, conserve and improve water quality, and alleviate flood damage and wetness problems through a combination of management practices, land treatment, and structural measures. Many different practices would be required on some of the same land; some would be recurrent in each planning period; and a number of measures would serve both improved watershed needs and production or other management objectives.

Erosion and sediment control practices would be applied on an additional 4.0 million acres of rangeland, 2.6 million acres of forest land, and 1.2 million acres of cropland between 1970 and 2020. Cropland practices include grade stabilization structures, diversions, ditch bank seeding, crop residue use, and shifts to pasture and hay use in areas of high erosion potential. In forested areas, trees and grass would be reestablished on eroding or deteriorating lands with particular attention following timber harvest. Existing or abandoned forest roads and trails would be stabilized. Rangeland practices include grass seeding to establish protective cover along with brush and weed control, contouring, and road stabilization. Accompanying these measures, more than 21,000 detention structures and small check dams would be constructed in cropland and rangeland areas.

Onfarm irrigation needs can be partially met through careful water management and increased efficiency of irrigation systems. Some systems now individually operated would be combined for more efficiency. Irrigation system improvement would include land leveling and shaping, ditch lining and pipelines to reduce transmission loss, with additional storage and control facilities. Along with major water storage facilities, almost 17,000 ponds and small reservoirs would be developed with capacity of some 119,000 acre-feet to serve irrigation, livestock, recreation, and wildlife needs and conserve early spring runoff. The largest number of these structures would be scattered in rangeland areas.

With other management practices on forest land, some 110,000 acres would receive special attention to water yield improvement.

This includes manipulation of forest cover on over 60,000 acres, almost 300 miles of snow fencing, and water spreading on 44,000 acres. Forest and rangeland require continuing protection and management practices to restore and maintain an effective vegetative cover for watershed objectives and for increased production. Grazing use of lands would continually be adjusted to the grazing capacity of the land. A substantial number of livestock and game water facilities would be developed for better livestock control and distribution. Timber sale contracts would include provisions for proper watershed protection practices, and improved harvest operations will assure a minimum temporary damage to the water and land. Continued fire protection and suppression would be effected in forest areas and critical rangeland areas. Watershed planning and management is a vital element to be included in all future land and resource development, and additional soil surveys and watershed plans would accompany future development.

A number of tributary stream control measures and adjacent land protection practices would help attain objectives in erosion and sediment control, flooding, and water conservation. About 4,200 miles of bank stabilization work is planned between 1970 and 2020 (1,800 miles in cropland, 1,500 miles in forest areas, and 900 miles in rangeland) along streams and reservoirs. Some 1,800 miles of dikes and levees would be constructed in croplands. Channel improvement work would be accomplished along some 7,700 miles of streams and rivers--about 3,400 miles in cropland, about 4,100 miles in forest land areas, and about 200 miles in rangeland. This includes a variety of practices such as removal of obstructions and debris, measures for reduction of pollution, improved water quality, and clearing the way for fish migrations.

Land treatment and management practices have been placed in similar groups and appear in table 77, Framework Plan Composition. Frequently, cooperative effort by a group of land managers and owners is necessary to effectively install a combination of practices, land treatment measures, and water conservation and control structures necessary to meet the more intensive multiple-use requirements of land and resources. Small watersheds have been identified (table 77) where the complexity of watershed problems and the multiple ownership of lands require such a coordinated effort. A substantial amount of the related land programs and practices included in the plan would be accomplished in these areas.

Coastal Zone and Estuaries

The coastal zone, as referred to herein, is the entire area of Subregion 10S except the drainages of the Umpqua River upstream from Scottsburg and the Rogue River upstream from Agness.

Included in the coastal zone is the entire coastline of Oregon from the California-Oregon border north to and including the Columbia River estuary upstream to Clatskanie. Of the approximately 500 miles of coastline, about 300 miles have usable beaches and the remaining 200 miles consist of headlands and rocky shores. On the central Oregon coast there are sand dunes of notable proportions, while south of Cape Blanco the dunes are comparatively small and widely separated. Between the Siuslaw River and Coos Bay these seacoast phenomena assume proportions which are of national significance.

Minor estuaries include the mouths of coastal streams such as the Rogue, Elk, Sixes, Pistol, Chetco, and Winchuck. The major estuaries are, from south to north, Coquille River Estuary, Coos Bay, Winchester Bay (Umpqua River), Siuslaw Bay, Alsea Bay, Haquina Bay, Siletz Bay, Salmon River Estuary, Nestucca Bay, Sand Lake (small embayment), Netarts Bay, Tillamook Bay, Nehalem Bay, and Columbia River Estuary (including Young's Bay). Of all the seaboard states, only three contain less estuarial area than Oregon. The 14 major estuaries total only slightly more than 56,000 acres but are invaluable to the region and the state because of the contribution they make to biological, economic, and social functions.

Approximately 83 miles of the Oregon shoreline are federally owned, while 158 miles are owned by non-Federal public bodies and 238 miles are privately owned. The public right to the use, for recreational purposes, of the coastal strip seaward of the natural vegetation line has been established by the Oregon State Legislature.

To date, relatively limited development has taken place in the coastal zone with such developments being related essentially to recreation, tourism, and navigation. There are approximately 60 parks and recreational areas along the coast maintained by Federal and State agencies, counties, and private power and timber companies. Facilities range from wayside rest areas along U.S. Highway 101 to large overnight parks encompassing several hundred acres each. Approximately 205 miles of shoreline have been developed to some degree for public recreation. Of the remaining 295 miles, about 110 are developed for nonrecreation purposes, while 103 are essentially undeveloped although both seasonal and permanent use are increasing. Under existing management policies, future development is expected to continue along existing patterns except for the probable construction of thermal powerplants required to meet the electric power demands of contiguous subregions. Excluding harbors on the Columbia River, the Oregon coast has two deep water harbors and 12 shallow draft harbors.

The coastal zone is less urbanized than other parts of western Oregon. Most of the larger communities are growing along

their suburban fringes. Considerable public attention is being directed toward the proposed construction of powerlines, condominium facilities, and high rise buildings which may affect the attractive character of the shoreline. Siltation and discharge of wastes into streams and estuaries have deteriorated the quality of such waters. The problem of deposition of dredging spoil is becoming acute as suitable areas become scarce. Considerable public pressure has been brought to bear within the last several years to limit or preclude highway construction on the Nestucca and Nehalem Spits.

Significant coastal zone conditions are discussed below.

Coos Bay Encompassing nearly 10,000 acres, nearly half of which is tidelands, Coos Bay is the largest Oregon estuary. Much recent attention has focused on this area because of the conflicts between major uses. As a deep draft port, it is an important industrial bay with log storage, lumber shipment, pulp manufacturing, fish processing, and other commercial uses. As a result, industrial pollution in the form of pulp mill effluent, log storage, tideland filling, and other use effects, threaten the Bay's biological productivity. The University of Oregon's Institute of Marine Biology also is located here.

Yaquina Bay With nearly 2,900 acres, Yaquina Bay is an important industrial, commercial, and natural resource bay. Not only is it the hub of the central coast's growing and important recreation/tourism industry, it also is the home of Oregon State University's Marine Science Center and Marine Research Reserve. While Yaquina Bay is the only coastal estuary for which a long-range water and land use plan has been prepared, its biological production continues to be threatened by upstream land uses, waste discharges, and potential accidental oil spills.

Alsea Bay The Bay is the basically pristine estuary of the Alsea River and totals about 2,200 acres. It is valuable in that its entrance has not been stabilized with jetties and thus offers engineers and scientists an opportunity to observe natural phenomena for comparison with estuaries that have been modified for navigation.

Salmon River Estuary, Sand Lake, and Netarts Bay The Salmon River estuary, relatively undeveloped and containing about 450 acres, is an excellent area for study of intertidal zonation of plants and animals. Sand Lake is a scenic high-salinity embayment of about 700 acres and is in a near primitive state. Netarts

Bay is a high-salinity, nearly pristine area of about 2,400 acres which are mostly tidelands. The Oregon State University estuary research area is near Whiskey Creek which flows into the Bay.

Columbia River Estuary and Young's Bay, (Oregon and Washington) Salt water intrusion on the Columbia River is measurable to a distance of about 20 miles above the mouth. This reach generally is considered to be the Columbia River estuary and includes the contiguous area of Young's Bay on the Oregon side and Baker and Grays Bays on the Washington side. At the upper end the estuary measures about 3 miles across, while the opening between the jetties at the mouth is about 2 miles; between these two points the estuary widens to a maximum width of 10 miles. Located generally in the upper part of the estuary are a number of islands, some of which are wooded, while others are open tidelands. Bars and shoals are characteristic features.

The natural flow regime has been altered to some extent by upstream reservoir regulation for flood control and power. Future power needs and the development of additional reservoirs in the upper reaches are expected to cause further modifications to the flow regime.

Of the several deep draft ports located on the Columbia River, only the port of Astoria lies within the estuary proper. A deep draft channel (40 feet existing project depth) is maintained in the river as far as Vancouver and Portland. Commercial navigation in the river ranges from log rafts to large oceangoing vessels up to 80,000 deadweight tonnage. Waterborne commerce in the lower river is increasing steadily and now averages about 30 million tons a year. Because of the large bedload in the river, a major dredging effort is needed to maintain the deep draft channel. A large number of charter boats and other recreational craft also use the estuarine and offshore waters. With the exception of the port city of Astoria, development of estuarine lands is limited to light residential and recreational facilities interspersed with a few small ports devoted to shallow draft navigation. Commercial fishing and fish processing are two of the major activities supporting the area's economy.

The Columbia River estuary provides migration routes and habitat for fish species of major importance to both the commercial and sports fisheries. All anadromous species using the stream system of the Columbia River pass through the estuary in their migrations to and from the ocean. In addition to providing passage, the estuary serves migratory fish as a zone of transition between fresh water and salt water. Salmon, the principal anadromous fish, supports commercial and sport fisheries both in estuarine and in offshore waters. Sturgeon are taken by both

commercial and sport fishing in the river, while groundfish, crabs, and shrimp are captured offshore. Substantial public investments have been made in upstream subregions for fish hatcheries and fish passage facilities across dams, and the continued return on these investments is dependent upon maintaining the satisfactory condition of the estuary for migrating fish. The estuary also provides habitat to waterfowl during fall and winter.

Coastal Zone (General) Because the needs of the Oregon portion are similar to those for Washington, needs are discussed in a general manner in the regional summary needs for the coastal zone and estuaries.

Numerous measures and actions will be necessary to preserve and enhance the environment of the coastal zone. Widespread regulation is necessary to assure that commercial developments and private recreation developments are harmonious with their surroundings. Streams to be considered for preservation in a free-flowing state are discussed in the preservation section. Small reservoirs are needed in numerous tributary drainages to provide recreation, fishing, and improved downstream flows.

Intelligent water and related land resource planning will require considerably more hydrologic, hydraulic, and water quality data than are now available for the fresh water streams, estuaries, and marine waters. Studies must relate water quality parameters with the hydrologic-hydraulic data and the needs for fish, wildlife, recreation, and other uses of the waters. Beach erosion areas and littoral processes must be studied in order to increase knowledge of these aspects to the point where adequate management programs can be developed.

Construction of recreation facilities, including trails, should be continued to assure that the projected demands are met. Recreation pressures probably will become such that critical deterioration of the environment and the recreation values could result by the 2000 period unless such use is regulated. Scenic roads and corridors should be expanded, particularly along U.S. 101 (the coast highway) and roads connecting the coast with interior areas. Also, a state level program to provide unified management of shoreline erosion control programs should be implemented. In summary, the needs of the coastal zone and estuaries can only be met adequately in the future if a coastal zone or state program of comprehensive planning and management is implemented to guide and control development in such a way as to preserve the unique environmental quality as well as insure a viable economy.

Nature and Extent of Further Studies

Although a plan has been recommended for this area, problems were encountered in formulating the plan for certain subareas and functions of water use. Data presently available, in addition to data expected to be generated through studies presently underway, listed in table 90, are not expected to be sufficient to develop a definite framework plan. Accordingly, studies are recommended for two river basins or subareas to further identify alternative methods, programs, projects, and uses of water and related land resources.

Malheur Lake Basin The propriety of future water resource development in the basin, particularly the Silvies River, probably will be determined on the basis of the effect on the Malheur National Wildlife Refuge. The framework plan is based on the tentative premises that (1) development of ground water is preferable to surface water and (2) the ground-water resource generally is adequate to meet the area's projected developmental needs. Therefore, the framework plan recommends early identification of the extent and availability of ground water and the effects of surface and ground-water withdrawals on the management of the refuge.

Coastal Drainage Basin Not unlike the Nation's other coastal areas, Oregon's coastal zone is widely considered as having a critical need for comprehensive planning and management. The primary areas of concern are the estuaries--those areas of high biological productivity and importance--and the unique scenic and esthetic values of Oregon's nationally famous shoreline. A cooperative local-State-Federal coastwide planning program will be conducted under the auspices of the Oregon Coastal Conservation and Development Commission. The program's purpose is to strike a balance between the zone's environment and economy. Accordingly, the zone's natural resources, primarily water and related lands, represent aspects of principal concern for which planning must be carried out on an accelerated schedule.

Hydrologic and hydraulic data of all kinds are sorely needed for the coastal zone, including fresh water streams, estuaries, and offshore waters. In addition, continuous capabilities for all aspects of coordinating water and related land resource planning must be available through fiscal year 1975 to meet the schedule and other requirements of Oregon's Coastal Program which are fully integrated with those of the Commission's comprehensive plan and Western United States Water Plan.

Table 90 - Studies Underway, Area C

Area	Purpose	Agency	Completion
Goldendale Division (Washington)	Multiple-Purpose	BR	1971
White Salmon (Washington)	Multiple-Purpose	BR	1971
Mill Creek (Washington)	Multiple-Purpose	CE	1975
Touchet River (Washington)	Flood Control	CE	1972
Little Klickitat River (Washington)	Multiple-Purpose	CE	1972
Stage Gulch, Stanfield	Flood Control	CE	1972
Rhea Creek	Multiple-Purpose	OSE-SCS-FS	-
John Day River	Multiple-Purpose	CE	1975
White River	Multiple-Purpose	BR	1974
Central Division, Deschutes	Multiple-Purpose	BR	1972
Columbia South Side	Multiple-Purpose	BR	1974
Umatilla Basin	Multiple-Purpose	BR	1973
Trout Creek	Multiple-Purpose	OSE-SCS-FS	-
Willamette River Basin	Warm Water Irrigation	EWEB	-
Oregon (Statewide, Type IV)	Multiple-Purpose	SWRB-USDA	continuing (1975)
Tualatin-second phase	Multiple-Purpose	BR	1976
Molalla and Pudding River Basins	Multiple-Purpose	BR	1976
Thomas Creek	Multiple-Purpose	CE	1973
Carlton Division	Multiple-Purpose	BR	1973
Willamette River Basin	Flood Plain Information	CE	-
Medford Division	Multiple-Purpose	BR	1975
Rosealea Division Umpqua River	Multiple-Purpose	BR	1973
Evans Valley Division Rogue River	Multiple-Purpose	BR	1974
Marcus Whitman-Milton Freewater	Multiple-Purpose	BR	1973
Columbia River at Bonneville Dam	Navigation	CE	1975
Lower Columbia River and Tributaries	Flood Control	CE	1977
Umpqua River	Navigation	CE	1976
Nehalem, Miami, Kilchis, Wilson, Trask, & Tillamook Rivers	Multiple-Purpose	CE	1973
Rogue River at Gold Beach	Navigation	CE	1974
Elk Creek at Cannon Beach	Flood Control	CE	1972
Umpqua River and Tributaries	Multiple-Purpose	CE	1972
Coquille River and Tributaries	Multiple-Purpose	CE	1973
Alsea River and Tributaries	Multiple-Purpose	CE	1973
Yaquina River	Navigation	CE	1972
Silvies River and Tributaries	Multiple-Purpose	CE	1973
Dixon Farm Levee Extension	Flood Control	CE	1972
Marys River	Multiple-Purpose	CE	1976
Luckiamute River	Multiple-Purpose	CE	1976
Calapooya Creek	Multiple-Purpose	SCS-FS	-
Little Butte Creek	Multiple-Purpose	OSE-SCS-FS	-
Ash Creek	Multiple-Purpose	OSE-SCS-FS	-
Mayer St. Park Channel	Navigation	CE	1973

Table 90 - Continued

Area	Purpose	Agency	Completion
Umatilla River and Willow Creek	Watershed Management	SCS	-
Columbia River and Tributaries	Multiple-Purpose	CE	1977
Illinois River	Wild River	FS	1975
Siuslaw River	Navigation	CE	1972
Vannoy Watershed	Multiple-Purpose	SCS-FS	-
Necanicum Creek	Multiple-Purpose	SCS-FS	-
Little Luckiamute River	Multiple-Purpose	SCS-FS	-
Grand Prairie	Multiple-Purpose	SCS-FS	-
McKay-Rock Creeks	Multiple-Purpose	SCS-FS	-
Lonerock-Sixmile Creeks	Multiple-Purpose	OSE-SCS-FS	-
Fifteenmile Creek	Multiple-Purpose	OSE-SCS-FS	-
Hudson Bay Watershed	Multiple-Purpose	SCS-FS	-
Deer Creek	Multiple-Purpose	SCS-FS	-
Oak Grove	Multiple-Purpose	SCS-FS	-
Rock Creek	Multiple-Purpose	SCS-FS	-
Upper Nehalem River	Multiple-Purpose	SCS-FS	-
Necanicum Creek	Flood Plain Information	SCS	1972
River Road section-Willamette River	Flood Plain Information	SCS	1972
Sandy River	Flood Plain Information	SCS	1972
Grand Prairie	Flood Plain Information	SCS	1972
Calapooia River	Flood Plain Information	SCS	1972
Lower Rogue River	Flood Insurance Study	SCS	1971
Lane County	Generalized Flood Plain	SCS	1972
Hood River County	Generalized Flood Plain	SCS	1972
Polk County	Generalized Flood Plain	SCS	1972
Lincoln County	Generalized Flood Plain	SCS	1972
Azalea Division, Umpqua	Multiple-Purpose	BR	1973
Oregon	State Water Plan	SWRB	1975
Oregon Slough	Navigation	CE	-
Siletz Bay	Navigation	CE	1974
Tillamook Bay & Bar	Navigation	CE	1976
Coos Bay Sand Dunes	Hydrology, Water Supply, Water Quality	GS	1972
Crater Lake National Park	Wilderness Classification	NPS	-
Mt. Hood Wilderness Addition	Wilderness Classification	FS	-
Sky Lakes	Wilderness Classification	FS	-
John Day Fossil Beds National Monument	Master Plan Study	NPS	-

Watershed Studies Studies are called for on 119 watersheds in the first time period and 65 more by 2000 in order to refine the inventory data, evaluate and select those most desirable and justified to meet the requirements of more detailed plans already scheduled.

Special Studies Table 91 lists special studies recommended for the area.

Table 91 - Special Studies, Area C

Type	Scope and Extent
Stream Preservation	Study of over 3,000 miles of streams to determine whether they should be included in a state or national system of rivers or preserved for recreation or fish habitat.
Environmental Protection and Development	A study to prepare a plan for preserving and enhancing qualitative aspects of the Willamette Valley's livability in harmony with expansion of the economy and population.
Scenic, Historical or Unique Areas	Identify scenic, historic and unique areas, and develop plan for preservation and public use.
Coastal Area and High Alpine Areas of Cascade Range	Determine on a statewide basis, level of human use commensurate with fragile ecological balance with emphasis on the coastal area and high alpine areas of the Cascade Range.
Scenic Roads	A study of scenic roads along streams and as access to other environmental values and development of a scenic road plan with proposals for improving scenic opportunities.
Habitat Improvement for Fish and Wildlife	Identify areas where habitat can be improved effectively and develop plan for improvement.
Thermal and Pumped Storage Power Sites	A study to identify and evaluate thermal and pumped storage power sites.
Minimum and Optimum Flow Requirements	Continue to study and evaluate minimum and optimum streamflow requirements for esthetics, water quality, and fishery values.
Flood Plain Information Studies	Identify location, extent, and frequency of floods.
Primitive Areas	Study approximately 355,000 acres of roadless area for possible inclusion in a Federal or State wilderness system.

Evaluations

General

The framework plan and programs for Area C were formulated to satisfy the projected functional needs that have been identified with full recognition given to environmental aspects. Storage facilities, flood control works, irrigation, and other structural elements of the plan would be located and designed to preserve as much as possible of the prime recreation, wildlife, and esthetic areas. Key environmental areas are not only preserved but enhanced under the plan. Specific elements of the plan are briefly stated in the following:

(1) Environmental and esthetic values would be enhanced by:

Future studies leading to the establishment of realistic minimum flows on all streams to improve esthetic values, fish and wildlife habitat, and to aid in pollution control.

Waste treatment to remove a minimum of 85 percent of organic wastes from municipal and industrial effluents by 1980 and 90 percent by 2000.

Study of over 3,000 miles of more than 70 streams to determine whether they should be included in state or national system of recreation rivers and subsequent designation of those found to qualify.

Study and consideration of 3,950 miles of stream for preservation and protection of fish habitat. The improvement of habitat on 17,200 miles of streams and 204,000 acres of lakes. Augmentation of the supply of fish from 40 hatcheries and 4,800 acres of rearing ponds. Provide access to 2,143 miles of streams and 438 access sites to lakes.

Acquisition of wildlife habitat on 665,200 acres and improvement on 1.6 million acres. Hunting access would be improved on 18.1 million acres. About 50,000 game birds would be produced annually on game farms in Washington.

Recreation development to provide for an increase of 17.1 million recreation days by 1980, 51.9 million days by 2000, and 114.0 million days by 2020.

(2) Food and fiber needs would be met by:

Withdrawal of an additional 5.5 million acre-feet of water (4.8 million acre-feet from surface water and 0.7 million acre-feet from ground water) for supplemental water for 477,000 acres of presently irrigated lands and 1,558,000 acres of new irrigation.

Multiple-purpose storage totaling 6.5 million acre-feet to augment flows for irrigation as well as to provide flood control, recreation, fisheries, electric power, municipal and industrial water, and water quality control. The final location and scoping of storage would be dependent on the plan selected by detailed interdisciplinary studies.

(3) Transportation needs would be met by:

Channel improvements for navigation, enlargement of two locks, and construction of 2 miles of breakwater.

(4) Watershed management and treatment needs would be met by:

Erosion and sediment control on 7.8 million acres; water conservation on 1.5 million acres; protection and management on 27 million acres; water yield improvement on 109,000 acres; drainage on 517,000 acres; bank stabilization on 4.2 thousand miles; 1,783 miles of dikes and levees; channel modifications on 7,731 miles; 21,181 erosion control structures; and 118,000 acre-feet of storage in 16,912 small ponds and reservoirs.

(5) Electric power would be provided by:

Sources located in the area and contributing to the region through installation of additional capacity of 1,604 MW at existing and new hydroelectric plants and 78,000 MW of thermal power by 2020, using evaporative cooling at inland locations and direct cooling in coastal areas with ocean water.

(6) Flood control would be provided by:

Flood plain management, including flood plain regulation, at 25 areas, flood proofing at 7 locations, protection provided by multipurpose reservoirs, and levees and channelization for 445 miles of streams. An unmet need would exist for this function as some residual damages on major streams would remain at 2020.

(7) Municipal, industrial, and rural-domestic water would be supplied by:

Expansion of existing supplies and extension of distribution systems into rural areas having inadequate or poor quality ground water. Present sources are generally considered adequate. About 1,535,000 acre-feet of additional water would be required to supply the 2020 needs.

(8) Further studies would be undertaken for:

The Malheur Lake basin and the coastal area to further identify alternative methods, programs, projects, and uses of water and related land resources.

More intensive studies on 184 watersheds to further identify problems, possibilities, and desirability in order to choose those most capable of helping meet plan requirements.

Ten special subjects requiring investigations to develop additional data.

In summary, the plan generally meets projected needs. Deficiencies in meeting supplemental water requirements for irrigation are offset by providing for the irrigation of additional new lands resulting in all food and fiber needs being met. Flood control needs are not entirely met as residual damages would remain at 2020. However, it is believed that the plan provides the proper balance between structural and nonstructural measures for flood control and with proper implementation would meet the economic efficiency objective. Power needs would be met by the plan except for a portion of the peaking requirement. Since a considerable number of pumped storage sites exist throughout the Columbia North Pacific Region, no problem is foreseen in meeting this requirement, provided, of course, that environmental conditions can be satisfied. Hunting needs would be met except for Willamette Basin where population pressures are too great.

Water Resource Situation

On an overall basis, consumptive water requirements can be met from available resources without serious depletions. However, there are several basins where additional storage and water conservation practices would be required to meet water needs. In total, diversions of surface waters and withdrawals of ground water would increase to 2-1/2 times their 1970 level by 2020 and involve about 8 percent of the available resource. About half of this water would re-enter the ground water or stream system as return flow, resulting in a net depletion of 4 percent of the available resoure by 2020. Consequently, after plan requirements in this area are met and without considering reduced inflows to this area from

upstream depletions, about 190 million acre-feet of the total 197[1] million acre-feet of water available per year would remain in the streams. The effect of upstream depletions is discussed in the regional summary of this appendix.

Although depletions for the area as a whole would be small in relation to total streamflows, some individual streams would be affected to a greater degree. Such streams as the Walla Walla and Umatilla Rivers where large amounts of new irrigation are planned would be depleted by as much as 50 percent of their 1970 flows. However, new storage reservoirs on those streams would make it possible to meet those needs and still increase flows in the streams during the low-flow season.

In total, annual ground-water recharge (34,000,000 acre-feet) is more than ample to supply present withdrawals (792,000 acre-feet annually) and additional withdrawals in the next 50 years (1,223,000 acre-feet annually). In some of the localized areas, ground-water pumping may exceed natural recharge as now occurs at Walla Walla, The Dalles, and Ordinance. Substantial use of ground water in the Silvies River subbasin during the 1970-80 period is predicated on the assumption that adequate supplies are available. Table 93 summarizes water diversions and depletions associated with the plan.

In addition to consumptive use of water, instream water uses are for electric power, navigation, fish, recreation, and water quality. These instream uses are discussed in the following paragraphs.

Hydroelectric power generation is a major water use on Columbia River, Deschutes River, North Umpqua River, Rogue River, and tributaries to Willamette River. Some other streams in the area also supply the energy for powerplants but to a lesser degree than those listed. Although only a few relatively small new hydroelectric powerplants are planned in the next 50 years, major additions are planned which would affect the hydraulic capacity of the Columbia River plants as shown in table 92.

1/ The 197,000,000 acre-feet is composed of: 128 million in Columbia River at Bonneville, 28 million in Willamette Basin, 40 million in the coastal streams of Oregon, including Umpqua and Rogue Rivers, and 1 million in the Oregon Closed Basin.

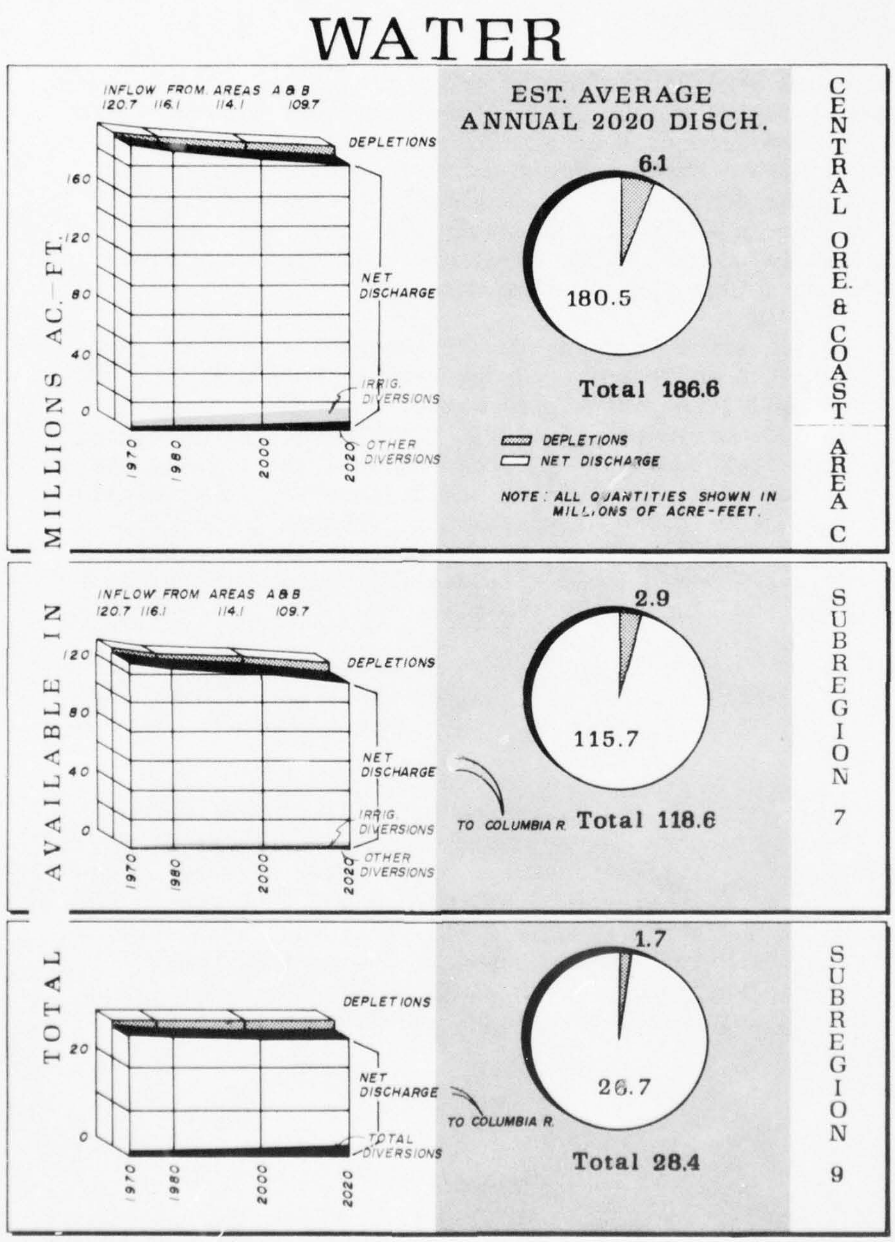
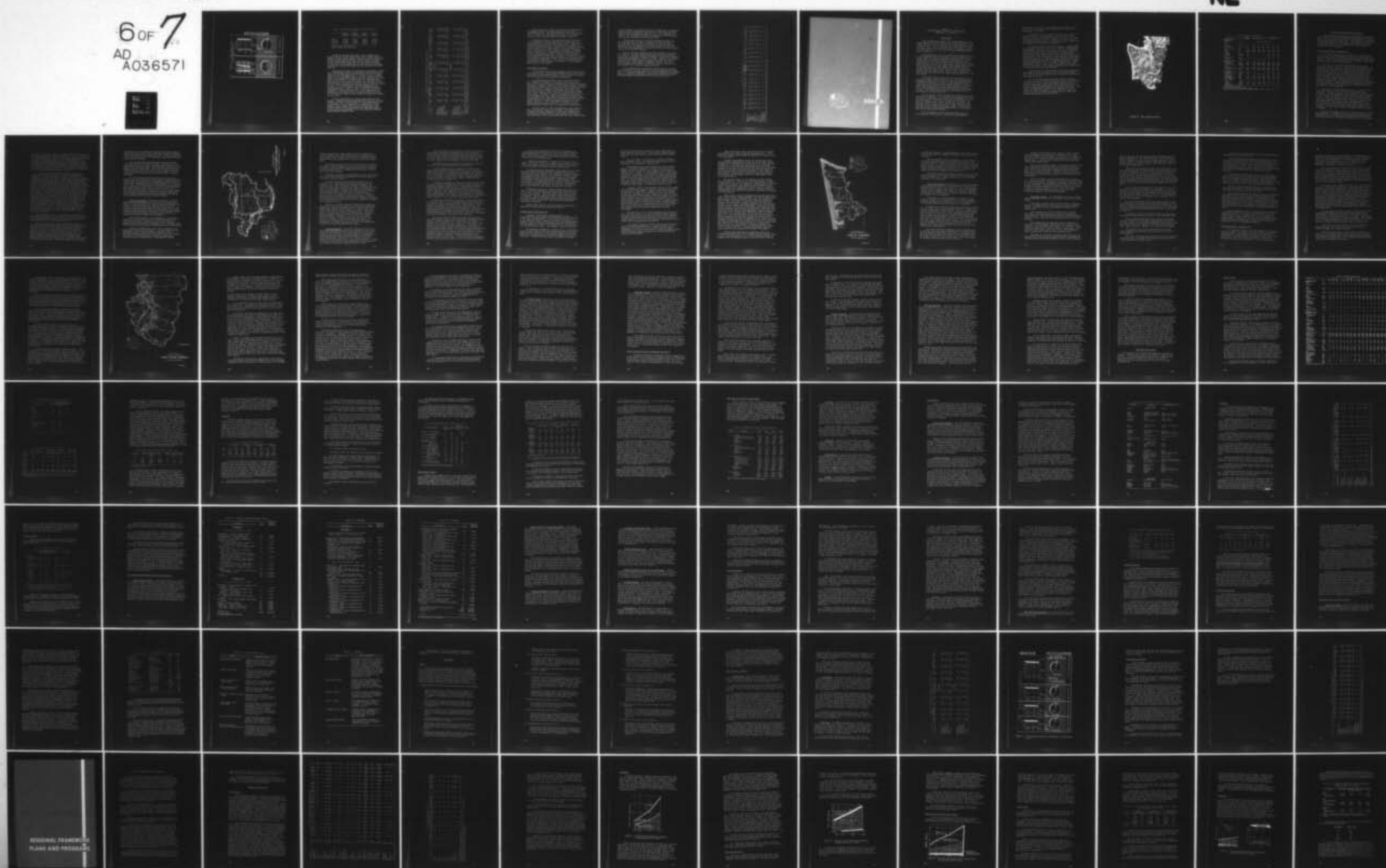


FIGURE 21. Projected Water Supplies, Withdrawals, and Depletions, Area C

AD-A036 571 PACIFIC NORTHWEST RIVER BASINS COMMISSION VANCOUVER WASH F/G 8/6
COLUMBIA-NORTH PACIFIC REGION COMPREHENSIVE FRAMEWORK STUDY OF --ETC(U)
JUN 72 E J GULLIDGE, H H RALPHS, C STEWART

UNCLASSIFIED NL

6 OF 7
AD
A036571



SITUATION

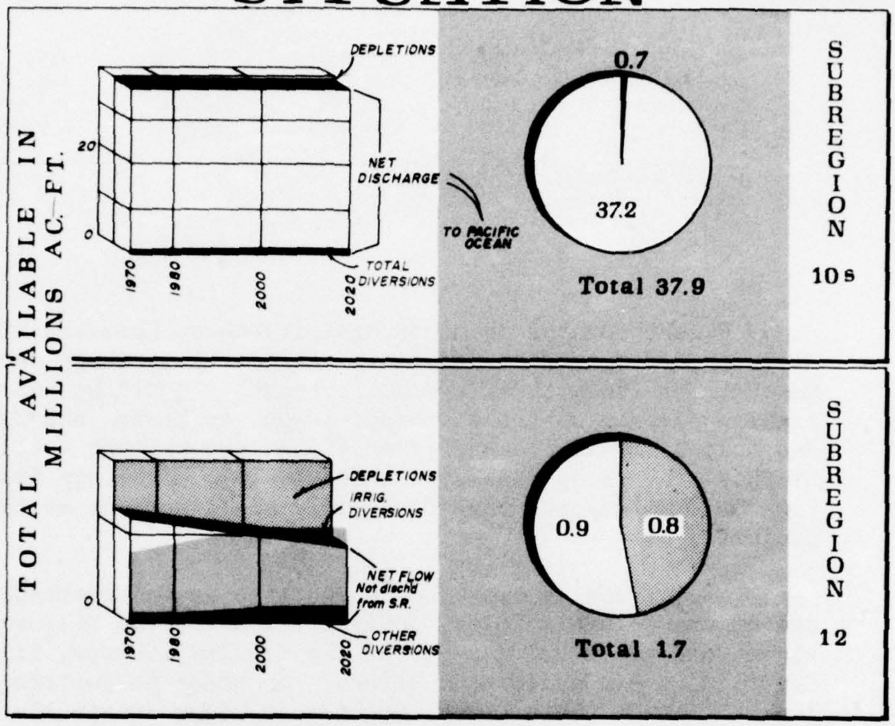

TOTAL AVAILABLE IN MILLIONS AC.-FT.
DEPLETIONS
NET DISCHARGE
TO PACIFIC OCEAN
TOTAL DIVERSIONS
20
0
1970
1980
2000
2020
0.7
37.2
Total 37.9
SUBREGION
10s
DEPLETIONS
IRRIG. DIVERSIONS
NET FLOW Not dischd from S.R.
OTHER DIVERSIONS
0.9
0.8
Total 1.7
SUBREGION
12

Table 92 - Planned Hydraulic Capacity of Columbia River Plants
Area C

	1970 Capacity 1/	1980 Capacity 1/	2000 Capacity 1/	2020 Capacity 1/
		(cfs)		
McNary	227,000	227,000	340,000	340,000
John Day	285,000	345,000	450,000	450,000
The Dalles	211,000	357,000	357,000	357,000
Bonneville	135,000	305,000	305,000	305,000

1/ Under normal plant operation.
Source: Appendix XV, Electric Power.

Except for the John Day project, these Columbia River projects are run-of-river plants with little storage capability. However, by 2000, their hydraulic capacity would be increased to utilize planned upstream storage in United States and Canada and most of available energy would be used without spillage. At that time it is estimated that the loss of energy from spilling would be 4 percent at Bonneville and 1 percent at the other projects.

Navigation is expected to continue as an important instream use of the Columbia River, lower portions of the Willamette and Rogue, and the tidal reaches of the Siuslaw, Chetco, Tillamook, Coquille, Coos, and Umpqua Rivers. In order to sustain navigation in the Columbia River immediately below Bonneville Dam, flow should be maintained at or above 58,000 cfs. Upstream from Bonneville Dam, water surface elevations are controlled by dams and navigation is theoretically possible even if flows are reduced to zero. (The requirements of the lower Columbia area are discussed in the Lower Columbia River and Washington Coastal Area presentation.) Flows of 5,000 to 6,000 cfs will maintain navigation in lower Willamette River. Flow requirements for navigation in the Oregon coastal streams previously listed are not critical since depths in the estuaries are governed primarily by ocean tides.

Fish use essentially all of the existing flows in area streams. Minimum and optimum streamflows for fish life have been identified for most of the streams, but such determination has not been made for the Columbia River. Columbia River flows should be at an adequate level to allow fish passage at the existing ladders, to provide guidance for downstream migrants, and to sustain the high quality sport and commercial fisheries downstream from Bonneville Dam.

Table 93 - Summary of Water Withdrawals and Depletions, Area C

Use	Ground				Surface				Total			
	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020
						(1,000 ac-ft)						
						Withdrawals						
Municipal	117	167	248	380	237	351	553	885	354	518	801	1,265
Industrial	142	169	233	322	342	452	592	732	484	621	825	1,054
Rural-Domestic	48	59	73	89	11	14	20	24	59	73	93	113
Irrigation 1/	476	723	1,056	1,165	3,751	5,990	7,365	8,602	4,227	6,713	8,421	9,767
Thermal Power	0	0	0	0	0	23	385	1,144	0	23	385	1,144
Fish & Wildlife	9	26	50	61	1,241	1,576	1,840	2,488	1,250	1,602	1,890	2,549
Other	0	0	0	0	0	0	0	0	0	0	0	0
Total	792	1,144	1,660	2,017	5,582	8,406	10,755	13,875	6,374	9,550	12,415	15,892
						Depletions						
Municipal	24	33	49	76	48	71	112	177	72	104	161	253
Industrial	8	10	15	19	29	38	46	57	37	48	61	76
Rural-Domestic	26	32	40	50	3	3	4	5	29	35	44	55
Irrigation 1/	289	455	668	741	1,968	3,165	3,968	4,754	2,257	3,620	4,636	5,495
Thermal Power	0	0	0	0	0	23	385	1,144	0	23	385	1,144
Fish & Wildlife	4	15	29	36	182	239	287	373	186	254	316	409
Other	0	0	0	0	0	0	0	0	0	0	0	0
Total	351	545	801	922	2,230	3,539	4,802	6,510	2,581	4,084	5,603	7,432

1/ About 20,000 acres of presently irrigated lands in Subregion 7 are served by diversion of 100,000 acre-feet of water from Subregion 3. Withdrawals shown above do not include this water as it is not withdrawn from Area C. However, depletions reflect this use to the extent that return flows from that diversion offset depletions from within Area C.

Many of the area's streams are used by recreationists for swimming and boating and simple enjoyment of the beauty of a free-flowing stream. Flow requirements for such uses vary with the size, slope, and other physical features of the channel itself as well as with the type of recreation involved.

Maintaining adequate water quality requires that flows in several streams be of such a magnitude that proper dilution and assimilation of residual wastes would occur. Major streams where such flow requirements are expected to be significant include the Walla Walla River and two of its tributaries (Touchet River and Mill Creek), Umatilla River, Hood River, Willamette River, including two of its tributaries (Tualatin and Pudding Rivers), Rogue River, including one of its tributaries (Bear Creek), and South Umpqua River. Projected waste loadings in the Columbia River in this area are small in relation to existing flows; however, high water quality standards exist, particularly in relation to temperatures. Flow levels in the Columbia River may have to be nearly as high as at present to insure adequate water quality in the future.

Land Resource Situation

Land resources are more than adequate to meet all projected needs and the area's environmental characteristics can be retained and enhanced with adequate planning. Table 94 shows the planned cover and land use by time periods and subregions.

The framework plan proposes nearly 1.6 million acres of new irrigation development in the 1970 to 2020 time period. Most of the increase would be accomplished by shifting nonirrigated cropland to irrigated cropland and the remainder would be converted from range and forest land. About half of the irrigation development would occur in Subregion 9 with about 30 percent being developed by private efforts from natural flows, ponds, ground water, and storage and about 70 percent by project-type efforts from storage. Subregion 7 would also support a major portion of the development with water supplied from storage, ground water, and pumping from the Columbia River through project-type endeavors. Smaller amounts of irrigation development would occur in Subregions 10S and 12. Most development in Subregion 12 would provide water for present inadequately irrigated cropland, about two-thirds of which would be supplied from ground water.

Land use shifts to other than agriculture would amount to only a small part of the total land area. The expansion of irrigated cropland in Subregions 7 and 9 would probably bring an increase in agriculturally related industry, particularly food processing. With the projected water and land transportation

systems available, the potential exists for other types of industrial expansion which, undoubtedly, would result in additional land areas being utilized for urban and industrial uses. The framework plan suggests that development be guided by comprehensive land use plans with specific regulations for flood plain uses.

Recreational land use is projected to expand markedly, but the total land shift is small in comparison to the area total. New wilderness areas and wild, recreation, and scenic rivers are potentials that are identified, but the plan calls for studies to select those most appropriate to satisfy the local and state interest as well as the national interest.

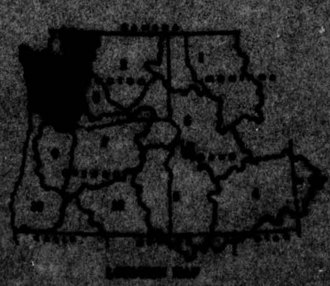
The area contains significant big game, waterfowl, and upland bird habitat. The total natural habitat is projected to decrease as a result of expanding cropland development, recreational expansion, and general development of roadways and towns. However, the big game animals and bird populations are expected to increase per unit of land area due to more intensive management measures. In areas where big game winter habitat is becoming scarce or critical, the plan provides for curtailing competing land uses.

It is essential that all potential uses for and use capacity of every parcel of land be considered in future planning and development. To insure that competing land resource developments are properly guided, a statewide comprehensive land use plan should be developed, establishing goals and priorities of use in each river basin.

Table 94 - Summary of Planned Cover and Land Use, Area C

	Planned Amount																			
	Subregion 7				Subregion 9				Subregion 10S				Subregion 12				Area C Total			
	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020
	(1,000 acres)																			
Area Cover & Land Use																				
Rangeland	6,358	6,176	6,162	6,106	59	55	50	48	115	107	101	94	8,733	8,743	8,722	8,761	15,263	15,081	15,035	15,009
Forest Land	8,328	8,274	8,206	8,118	5,272	5,234	5,058	5,091	10,155	10,130	10,094	10,060	1,893	1,874	1,842	1,805	25,648	25,512	25,200	25,074
Commercial	(6,516)	(6,472)	(6,415)	(6,363)	(4,961)	(4,923)	(4,747)	(4,780)	(9,625)	(9,600)	(9,564)	(9,529)	(1,409)	(1,400)	(1,390)	(1,373)	(22,511)	(22,395)	(22,116)	(22,045)
Non-Commercial	(1,812)	(1,802)	(1,791)	(1,755)	(311)	(311)	(311)	(311)	(530)	(530)	(530)	(531)	(484)	(474)	(452)	(432)	(3,137)	(3,117)	(3,084)	(3,029)
Cropland	3,571	3,729	3,735	3,805	1,456	1,384	1,420	1,250	423	364	330	307	365	363	400	385	5,815	5,840	5,885	5,747
Irrigated	(525)	(834)	(918)	(1,188)	(244)	(417)	(824)	(970)	(163)	(229)	(233)	(255)	(317)	(324)	(365)	(365)	(1,249)	(1,804)	(2,340)	(2,778)
Non-Irrigated	(3,046)	(2,895)	(2,817)	(2,617)	(1,212)	(967)	(596)	(280)	(260)	(135)	(97)	(52)	(48)	(39)	(35)	(20)	(4,566)	(4,036)	(3,545)	(2,969)
Other Land	565	625	681	745	816	911	1,031	1,156	293	371	434	494	404	413	424	436	2,078	2,320	2,570	2,831
Urban & Industrial	(81)	(86)	(93)	(101)	(555)	(613)	(683)	(770)	(79)	(84)	(92)	(101)	(8)	(8)	(9)	(9)	(723)	(791)	(877)	(981)
Remainder	(484)	(539)	(588)	(644)	(261)	(298)	(348)	(386)	(214)	(287)	(342)	(393)	(396)	(405)	(415)	(427)	(1,355)	(1,529)	(1,693)	(1,850)
Total Land Area	18,822	18,804	18,784	18,774	7,603	7,584	7,559	7,545	10,984	10,972	10,959	10,955	11,395	11,393	11,388	11,387	48,804	48,753	48,690	48,661
Water Surfaces1/	126	144	164	174	106	125	150	164	84	96	109	113	63	65	70	71	379	430	493	522
Total Area	18,948	18,948	18,948	18,948	7,709	7,709	7,709	7,709	11,068	11,068	11,068	11,068	11,458	11,458	11,458	11,458	49,183	49,183	49,183	49,183
Ancillary Land Uses																				
Fish & Wildlife	18,257	18,179	18,103	18,029	6,787	6,673	6,528	6,389	10,691	10,601	10,525	10,461	10,991	10,980	10,964	10,951	46,726	46,433	46,120	45,830
Water Related Recreation Facility Development	3	4	7	13	3	15	27	51	3	8	14	26	-	-	1	1	9	27	49	91
Total Irrigated Area	553	860	950	1,222	244	430	850	1,000	168	234	238	260	327	334	368	368	1,292	1,858	2,406	2,850

1/ Includes only large water bodies over 40 acres and streams over 1/8 mile in width. Smaller water areas are included in "Other Land" catagory.



AREA D

AREA D
WESTERN WASHINGTON AND LOWER COLUMBIA RIVER
SUBREGIONS 8, 10N, and 11

Description

This planning area contains all of Washington west of the Cascade Mountain Divide and the drainage to the Columbia River in Oregon downstream from St. Helens to just beyond the mouth of the Clatskanie River. The area contains 264 square miles in Oregon and 24,665 square miles of land and water in Washington, exclusive of 2,500 square miles of salt water in Puget Sound and adjacent waters (figure 22).

Physiographically, the area comprises the northern portion of the Willamette-Puget Sound Trough, the western slope of the Cascade Range, the Olympic Mountains and Willapa Hills, and the Coastal Area with estuaries--from the Canadian border to the Columbia River. The area is bounded on the east by the Cascade Range and on the west by the Pacific Ocean. Major streams include those draining into the Puget Sound, those draining the western Cascade watersheds into the Columbia River, and the coastal streams whose watersheds are the westerly slopes of the Olympic Mountains and the Willapa Hills. Major estuaries included are those within Puget Sound and the adjacent waters, Willapa Bay, and Grays Harbor.

The climate ranges from maritime in the coastal area west of the Coast Range to alpine near the crest of the Cascade Range, depending on variations in elevation. Mean annual precipitation is generally high along the coast, varying from 80-120 inches except the 240-inch extreme in the Olympic Mountains. The Puget Sound Trough experiences mean annual precipitation within the 25-50 inch range which increases to about 100 inches in the high Cascades. The temperatures within this planning area are mild and extremes are rarely experienced.

Over 80 percent of the area lands are forested; while about 6 percent are croplands. These croplands are primarily located in the alluvial plains along the eastern side of Subregion 11, in the interior valleys of the Chehalis and Cowlitz River Basins, and along the Columbia River. In the coastal area, dairying is the principal source of farm income, while a large variety of crops are grown in the Willamette-Puget Sound Trough. A rapid change from agricultural to urban and suburban land use is occurring in parts of the Puget Sound Subregion.

The 1970 population of the planning area was 2,611,427 with 86 percent of these people in the Puget Sound Subregion.

The largest city, Seattle, had a population of 530,831. Other major cities in the area include Tacoma, Everett, Bremerton, Bellingham, and Vancouver.

The primary industries include pulp and paper, lumber and other wood products, primary metals, food products, chemical products, and diversified manufacturing. The largest water user is the pulp and paper industry. Slightly less than a third of the employed population work in manufacturing--mostly lumber and wood products and transportation equipment.

The principal water and related land needs, shown in table 95, are directly related to some of the economic, physiographic, and geographic conditions which exist in the area. Because the area along the east shore of Puget Sound and adjacent waters is becoming urbanized rapidly, the urban and associated needs, rather than the rural, should be the focus for this portion of the planning area. This rapid change in land use points toward some critical elements of this framework plan. Recreation is a major function and planning element, considering that the area contains the entire Washington coast, the Strait of Juan de Fuca, Puget Sound and the adjacent waters, the Lower Columbia River, and three national parks: Mount Rainier, Olympic, and a major portion of the new North Cascades National Park.

The estuarine and coastal waters are currently undergoing development pressures for port as well as recreation purposes. These conflict with fish and wildlife uses and have potentials for water quality problems.

Because of the growing shortage of outdoor recreation facilities in the area, there is an urgent need for new facilities and additional access to existing natural recreation areas. Another primary and critical need for this planning area is for the preservation and enhancement of the natural environment. All future development must consider those measures which will enhance the total environment. At the same time, industrial, commercial, and agricultural development must be planned and guided to meet social and economic needs.

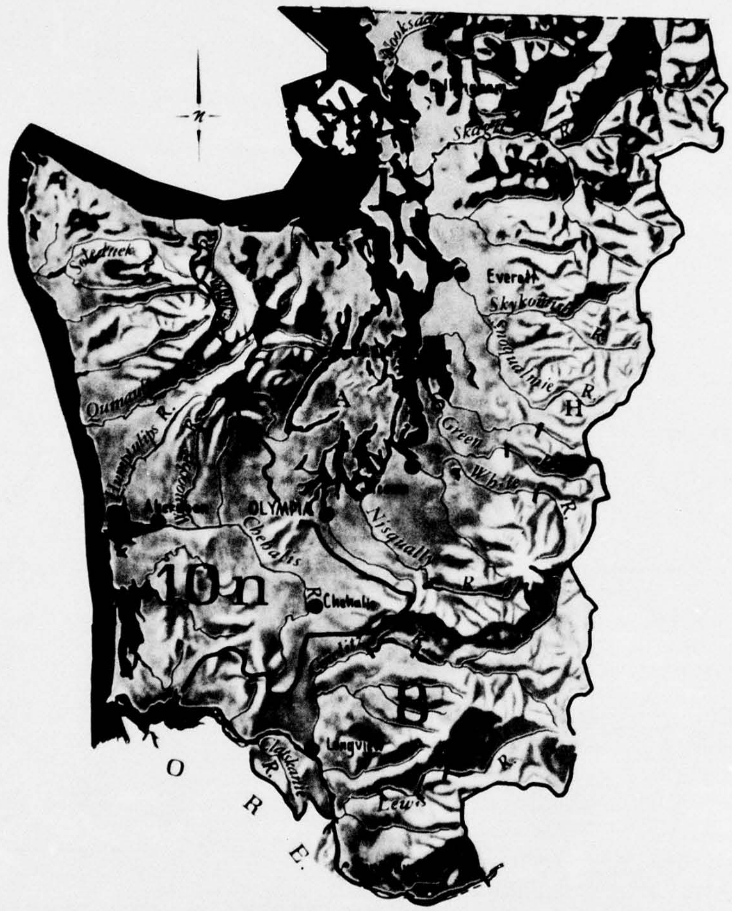


FIGURE 22. Plan Formulation Area D

Table 95 - Needs Summary, Area D, Columbia-North Pacific Region

Purpose or Function	Units	Current (1970) Development	Projected Gross Needs 1980	2000	2020	Residual Needs 1980	2000	2020
Water Development and Control								
Electric Power								
Capacity (Peak)	mw		Only Projected on a Regional Basis					
Energy	mil kwh		" " " " " "					
Navigation								
Commerce	1,000 tons	79,900	112,300	188,500	334,500	32,400	108,600	254,600
Water Quality Control								
Raw Waste Production 1/	1,000 p.e.	24,560	29,358	36,678	44,643	4,798	12,118	20,083
Waste Removal 1/	1,000 p.e.	9,654	21,976	27,285	33,336	12,322	17,631	23,682
Municipal and Industrial Water								
Supply	mgd	1,435	1,981	3,065	4,377	546	1,630	2,942
Municipal	mgd	(349)	(536)	(831)	(1,363)	(187)	(482)	(1,014)
Industrial	mgd	(1,064)	(1,420)	(2,200)	(2,969)	(356)	(1,136)	(1,905)
Rural-domestic	mgd	(22)	(25)	(34)	(45)	(3)	(12)	(23)
Flood Damages								
Major Streams 2/	Ann. $1,000	9,722	-	-	-	14,161	24,397	45,274
Bank Erosion 2/	Ann. $1,000	1,391	-	-	-	1,556	2,061	2,588
Areas Flooded 2/	1,000 ac-ft	405	-	-	-	405	405	405
Irrigation								
Total Irrigated Area	1,000 ac	142	253	317	400	111	175	258
Water Short Area	1,000 ac	(0)	-	-	-	(0)	(0)	(0)
Water Supply	1,000 ac-ft	313	528	655	851	215	342	538
Water and Related Land Programs								
Fish and Wildlife								
Commercial Fishery	1,000 lbs	162,567	237,257	314,177	410,651	74,690	151,610	248,084
Sport Fishing	1,000 days	9,247	14,792	22,268	33,726	5,545	13,021	24,479
Resident Species	1,000 days	(4,529)	(7,274)	(11,083)	(17,178)	(2,745)	(6,554)	(12,649)
Anadromous, Marine, Shell	1,000 days	(4,718)	(7,518)	(11,185)	(16,548)	(2,800)	(6,467)	(11,830)
Hunting	1,000 days	1,719	2,715	4,101	5,173	996	2,382	3,454
Water Related Recreation								
Development	1,000 rec days	29,100	46,000	102,200	207,100	16,900	73,100	178,000
Reg. Surface Water Use 3/	acres	186,500	289,100	574,900	1,080,700	102,600	388,400	894,200
Land Area (Rec. Facility Development)	acres	6,700	21,100	38,300	72,400	14,400	31,600	65,700
Pleasure Craft	no. (1,000)	214	338	642	1,209	124	428	995
Watershed Management								
Flood Damages--Minor Streams 2/	Ann. $1,000	12,097	-	-	-	16,098	24,013	36,457
Area Flooded 2/	1,000 ac	566	-	-	-	566	566	566
Erosion and Sediment Control	1,000 ac	378	583	952	1,324	205	574	946
Drainage	1,000 ac	335	396	488	565	61	153	230
Beach Erosion Control	miles	-	-	-	-	200	200	200
Bank Stabilization	miles	211	697	1,222	1,730	486	1,011	1,519
Levees and Floodwalls	miles	443	617	879	1,138	174	436	695
Channel Improvement	miles	444	1,481	2,721	3,809	1,037	2,277	3,365
Protection and Management 4/	1,000 ac	12,847	12,850	12,787	12,631	12,762	12,699	12,577
Water Conservation	1,000 ac	122	242	309	390	120	187	268
Water Yield Improvement	1,000 ac	0	6	60	113	6	60	113
Related Land Production								
Croplands	1,000 tons	786	774	973	1,254	-12	187	468
Irrigation	1,000 tons	(213)	(422)	(568)	(998)	(209)	(355)	(785)
Dryland	1,000 tons	(573)	(352)	(405)	(256)	(-221)	(-168)	(-317)
Forest Wood Fiber	mil cu ft	1,431	1,702	2,002	1,956	271	571	525
Range Grazing Capacity	1,000 aum	36	36	37	37	0	1	1

1/ Includes municipal, industrial, and recreation use.
2/ Needs over 1970 level of flood prevention.
3/ Gross needs, existing use of water surface not considered.
4/ Includes recurrent programs that will require acceleration with implementation of a plan.
Residual needs cannot be determined by subtracting current development from gross needs as many of these practices are applied annually on the same areas.

Formulation of Area Plans and Programs

The following section discusses the planning considerations which include the needs and problems, the opportunities and alternatives to meet the needs, and finally some generalities concerning the framework programs by time frame. Following this section is a separate descussion of the shorelands and estuaries, and finally the specific elements of the framework plans and programs are shown by individual functions.

Lower Columbia Subarea (Subregion 8)

This subarea contains 5,103 square miles, with more than adequate land and water available for agricultural development to meet its assigned portion of projected food and fiber needs. Major tributary river basins include the Cowlitz and Lewis in Washington, and the Clatskanie in Oregon (figure 23).

The rivers are well used by recreationists, contain a significant fishery, and have a large supply of good quality water. The Cowlitz and Lewis Basins contain the only storage reservoirs exceeding 5,000 acre-feet. Two reservoirs on the Cowlitz River have an active capacity of 1,318,380 acre-feet and three on the Lewis River contain 882,530 acre-feet of active storage. The primary purpose of the projects is to generate electric power, but they also provide municipal water supply, flood control, sport fishery, and recreation. These streams and others such as the Washougal, Kalama, Toutle, Elochoman, and Grays Rivers in Washington and the Clatskanie in Oregon support an outstanding sport fishery for steelhead, salmon, and trout and meet a significant share of the region's sport fishing needs.

The land is 85 percent forested, which is reflected by the large employment in the pulp and paper and wood processing industries. Although 35 percent of the subregion (1,116,000 acres) is suitable for crop production, only 201,000 acres are currently so used. Projected land uses indicate only minor shifts in the forest and rangeland categories, but a major shift of some 85,000 acres from croplands to other lands is expected, primarily for urban expansion in the Vancouver-Camas and Longview-Kelso area. The rapid growth in these two areas, particularly near Vancouver, indicates a critical need for water and land use planning. For instance, over 6,000 acres of urban and suburban lands are subject to flooding.

Municipal and industrial water is supplied from both surface and ground water. Although overall supplies appear adequate, some municipalities are haveing problems obtaining sufficient amounts from individual wells. Municipal and industrial water requirements

are expected to increase about 115 percent by 2020. With increased irrigation and municipal supplies requiring the largest amounts of water during periods of lowest streamflows, storage may be required. To avoid conflicts with instream uses, storage would best be provided in the higher headwater reaches of the streams. Water pollution control and abatement plans are now being prepared for this subregion by the State of Washington. Ground-water studies are necessary to determine the quantity and quality of supply, and surface-water studies are needed to establish minimum streamflows for fish, water quality, and esthetic purposes.

To meet the 2020 food and fiber needs assigned to this subregion, an additional 78,000 acres must be brought under irrigation. All of the presently irrigated 18,000 acres have an adequate water supply, and there is enough land and water available to meet the projected need. Most of the irrigation development is expected to occur in Washington, primarily in two general areas. One area of about 45,000 acres, located near Brush Prairie between Vancouver, Woodland, and Battleground, could be served from the Lewis River by storage on Salmon Creek or with water pumped from the Columbia River. A large portion of this area is class 1 irrigable land. Another area of 30,000 acres along the Cowlitz River could be served by low pump lifts or gravity diversion from the river or its tributaries. Storage on tributaries of the Cowlitz River may be required to maintain adequate stream levels at and below the points of diversions. Class 2 and 3 lands are prevalent in this portion of the subregion. In Oregon, about 3,000 acres of low-lying lands along the Columbia River near the communities of Rainier, Clatskanie, and Deer Island could be irrigated by low-lift pumping from wells or the Columbia River. These lands are largely classes 2 and 3. With ample water supply and over 200,000 acres of class 1 and 2 land in this subregion, the alternatives are generally a matter of selecting the areas best suited for development.

More than 87,000 acres of cropland have wetness problems and projections indicate that additional irrigation will increase this amount to 92,000 acres by 2020. Most wet areas could be drained during the 4 to 5-month growing season.

Measures to supply the regional power needs include installation of additional generating units at existing plants on the Lewis and Cowlitz Rivers. Three undeveloped hydroelectric sites on these rivers offer possibilities but have not been included in the plan. A potential pumped storage project at Merrill Lake could provide about 500 MW of peaking power, but this development, like the other hydro possibilities, would conflict with environmental aspects and lake drawdown would reduce recreation use. Additional power is expected to be supplied by thermal-electric plants. One nuclear-thermal plant now under

construction in this subregion will provide 1,130 MW of capacity. Projections indicate that nearly 12,000 MW of additional thermal-electric generation will be required by 2020. Specific plant sites have not been selected but site selection studies should be undertaken in the near future.

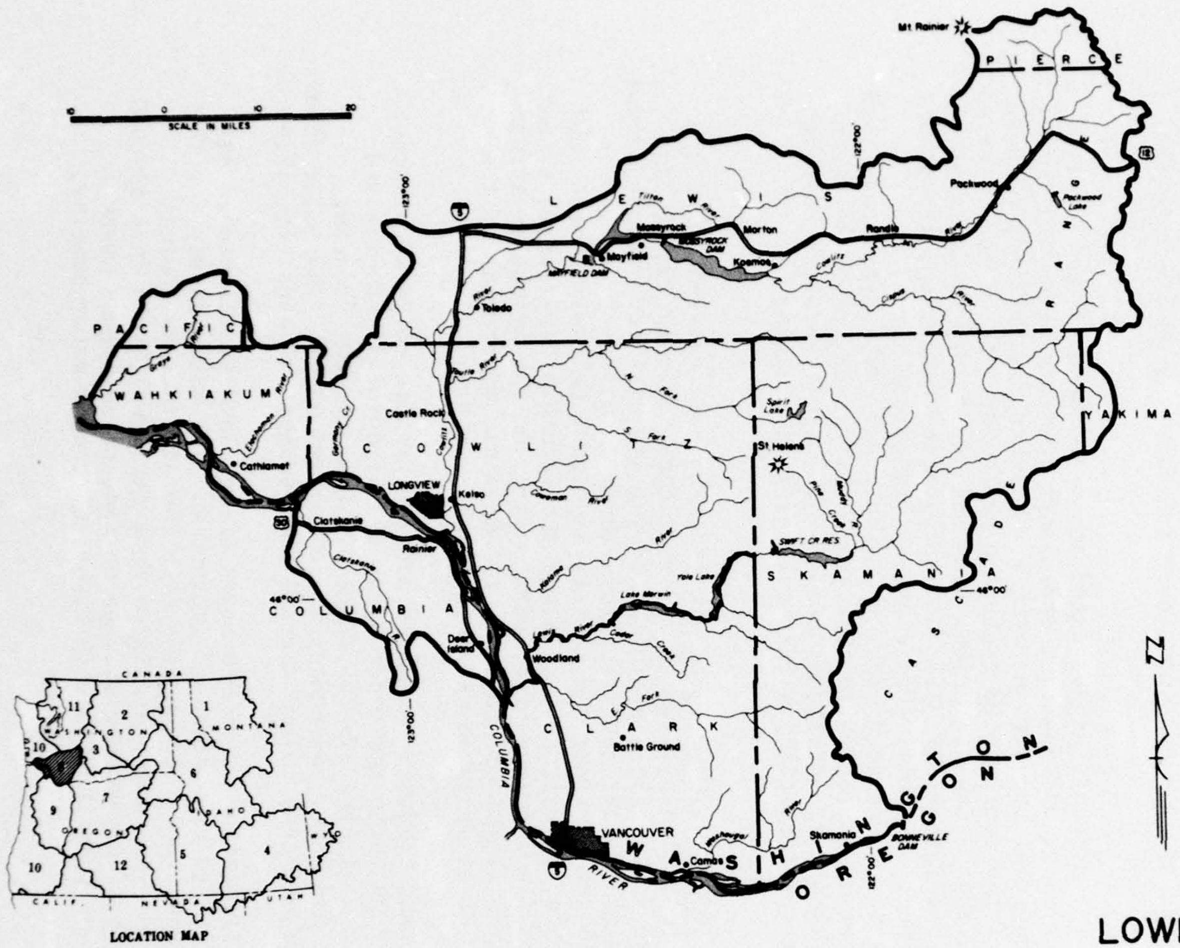
The regional study of peaking power resources did not include an area selection study. However, indications are that some peaking capacity, probably from pumped-back storage, will be needed in this area after 2000. Site selection studies should be undertaken shortly after 1980. These site selection studies are probably the most critical, involve the widest range of alternatives, and are the most controversial from the public interest standpoint.

The present and projected needs and uses of the lower Columbia River and adjacent shorelands indicate potential conflicts and thus point out the need for a comprehensive multiple-purpose study of the coordinated operation and management of the river and its environs. Considerations must include future dredge disposal areas, irrigation, wildlife habitat, recreation areas, industrial and commercial areas, scenic areas, historical sites, and other water-associated water and land uses. Many areas developed for water-based recreation are generally crowded on summer weekends; therefore, additional access and recreation sites must be a major consideration in future waterfront planning.

1970 to 1980 Program During the next decade, the flood damage reduction program on major streams includes controlling land use in the flood plains by zoning statutes and building codes, 5 miles of channel rectification, about 21 miles of new and improved levees along the Cowlitz and lower Columbia Rivers, and 35 miles of bank protection along the Columbia River levee system. Improved flood forecasting, particularly on the tributary streams, is another improtant program. The Mayfield powerplant of the Cowlitz River would be expanded by 41 megawatts.

Land treatment measures are recommended on 24 watersheds. Included in these and other areas are structural measures and nonstructural programs to reduce erosion, prevent flooding, improve drainage, and conserve and control water. The major effort would be directed toward channel improvement and bank stabilization.

Irrigation of 35,000 acres of new land is planned in the Brush Prairie area north of Vancouver. The water supply for this development could be supplied from the alternative sources mentioned previously--diversion from the Lewis River into 150,000 acre-feet of off-stream storage or storage on Salmon Creek, diversions from the Columbia River, or ground-water pumping.



COLUMBIA-NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

LOWER COLUMBIA SUBAREA

LOWER COLUMBIA SUBREGION 8

FIGURE 23

Storage on Salmon Creek would conflict with fish spawning and wildlife habitat areas. Three thousand acres of scattered bottom land adjacent to the Columbia River would be irrigated by waters supplied from either ground waters or diversion from the Columbia River.

The Columbia River and some of the tributary streams would be dredged to greater depths in later years to meet the projected navigation needs; therefore, multidisciplinary studies concerning the handling and disposal of dredge spoil must be made in conformance with a land use plan.

Industrial, municipal, and rural-domestic water supply needs can be met without problem by expanding the existing systems and utilizing the current supplies.

The State and Federal water quality standards will be complied with in accord with the water pollution control and abatement plans. Waste collection, handling, treatment, and disposal are presently problems in the rapidly developing Vancouver area as the provision of necessary facilities is not keeping current with the needs. By 1980, the situation will be improved with treatment levels that meet the 85 percent BOD removal criteria. This will improve the quality of water in Vancouver Lake which has an excellent recreation potential but is now too polluted to permit water contact recreation. Nonpoint discharges, such as urban and rural land runoff, will be controlled by improved land management practices.

Reaches of 11 streams should be studied and evaluated for retention as free-flowing streams and for recreation development. Minimum flows should be established on most major streams for fishery needs and for esthetic purposes. Wildlife refuge areas should be provided on and near the Columbia River. This need would be evaluated in the previously mentioned and recommended multiple-purpose, comprehensive study of the lower Columbia River and environs. Increase in electric power generating capacity is planned for both thermal and hydro sources. The Trojan nuclear thermal plant will be completed about midway through the time period, and additional units are considered for installation at existing hydroelectric plants.

Long-Range Program During the intermediate period, the flood plain management program developed during the early action period would be continued. The levees along the Cowlitz River through the towns of Kelso and Longview would be strengthened to provide better protection to urban development, and existing single-purpose power reservoirs on the Lewis River would be operated to obtain multiple use of their storage capacity. A total of 130 miles of new levees, levee improvements, bank protection, and channel rectification are planned for this period.

The land treatment program would be continued by structural installations and watershed management practices on cropland, forest land, and rangeland to provide water conservation on the cropland, reduce erosion, provide drainage, and prevent flooding on all the lands within the subregion. Thirteen watershed areas have been designated for development during this time frame.

Ten thousand acres of irrigation are planned for the lower Lewis River area around Woodland using ground water.

A major dredging program to deepen the Columbia River channel below Vancouver is planned for this period. Detailed studies are required to determine the exact depth, but an increase of 5 to 10 feet over the existing 40-foot channel with greater depth at the mouth, is tentatively planned. Because dredge spoil will total millions of cubic yards, land-use regulations for disposal areas must be adhered to.

No widespread problems are foreseen in satisfying the future water supply needs, although some isolated systems may require storage to supplement seasonal flows. No problems of quality are anticipated; however, high iron saline concentrations can be expected from some wells and turbidity will be a problem from surface supplies. These problems can be treated on an individual basis. Water quality will require a continuation of the program of pollution control. The collection and treatment for removal of organic material will be increased to 90 percent BOD removal.

Recreational areas must be expanded to include more boating on lakes and rivers. Nearly 200 additional boat launching lanes are planned to satisfy the recreational boating needs. Conflicts between recreational and commercial uses of the waterways are expected to increase, necessitating more regulatory control to maintain safe and efficient use of the waterways. Additional overnight camping and picnicking areas should be developed, and a continued expansion of scenic roads, access areas, and recreational facilities will improve recreation in the subregion.

The fishery resource would be protected and improved by continued programs of habitat preservation and improvement, harvest would be increased through access improvements, and supplies augmented by two hatcheries and 75 acres of rearing ponds. Other measures would implement wildlife management. Establishing a white-tail deer refuge, leasing or acquisition of islands, and raising game birds are planned. The streams analyzed and selected for recreation or other uses in the first time period would be retained and used for environmental and other purposes. Thermal powerplants would be constructed during this period with an estimated 5,850 mw of capacity. Cooling waters would not be allowed to return to the streams. A total of 203 mw of hydropower would be added to existing plants on the Lewis and Cowlitz Rivers.

In the last time period, the flood plain mangement and structural programs, primarily 124 miles of levee work along the lower Columbia River, are planned to proceed at about the same rate as the preceding period. Watershed improvement programs are planned for seven watershed areas.

Irrigation development is planned on 30,000 acres of new lands in the Cowlitz River area. Natural flows, ground water, and 30,000 acre-feet of storage in the upper portion of the drainage basin would provide the 81,000 acre-feet water required.

No major navigation improvements are planned for this period but shore-support facilities would be expanded and improved to handle the increased commerce. The coordinated program of disposal of maintenance dredge spoil would be continued. Launching ramps and moorage facilities would be expanded and improved to handle the projected increase of approximately 50,000 pleasure boats. Water supplies, including any necessary storage, would be developed as required, and no major problems are foreseen. Treatment of wastes would generally continue at the same level of efficiency but in some localized areas higher levels may be necessary.

Additional recreation is planned through land acquisition, intensive facility development, and expansion of water surface area. Scenic, historic, and high esthetic value areas will also be noted and preserved. Major fish and wildlife programs would be continued. Habitat improvement would continue at about the same rate, stream and lake access would be accelerated, hatcheries increased by three, and wildlife land acquisition and habitat improvement accelerated.

Thermal power capacity with recirculated cooling water or evaporative cooling would be increased by 6,000 MW.

Coastal Subarea (Subregion 10N)

Althought the Washington Coastal Subregion is not experiencing the rapid population and industrial growth occurring in the Puget Sound Subregion, it is indirectly realizing the strain from this growth. Recreation, fishing, and hunting demands along the coast and within the two major estuaries--Willapa Bay and Grays Harbor--are results of the growth in the Seattle-Tacoma and Portland-Vancouver areas. The subarea is shown on figure 24.

The subregion's prosperity is closely tied to the extensive forests and the seacoast with their related recreation activities. Large pulp and paper mills in the Aberdeen-Hoquiam area on Grays Harbor are the leading industry and require commercial navigation facilities. Seafood processing plants and commercial fishing,

particularly charter boat operations, attract large numbers of people and boats to the coast. Ilwaco on the Columbia estuary and Westport on Grays Harbor are the leading ports for charter fleets.

The water rights of the Chehalis, Shoalwater, Quinault, Hoh, Quillayute, Ozette, and Makah Indian Reservations must be considered in the planning of Subregion 10N.

Flood damages occur in the flood plains of the Willapa, Chehalis, Newaukum, Skookumchuck, Wishkah, and Satsop Rivers. Damages also occur along the tidal reaches of the Willapa and Chehalis Rivers. Future use and development of the flood plains are expected to continue, thus indicating a need for flood plain regulation. Flood control storage does not appear economically feasible and levees are feasible only in areas of major development. The entire Subregion 10N contains only 162,000 acres of cropland of which 13,000 acres are irrigated. Much of the non-irrigated cropland could be irrigated but seasonal low flows will necessitate some storage if surface waters are to be used.

Irrigation storage in the Willapa River Basin, plus ground water in other areas, would be utilized to satisfy the projected irrigation water requirements. However, most of the proposed Willapa River storage is for augmenting low flows for fish and for municipal and industrial use. Ground-water supplies must be studied further for a firm delineation of the amounts that can be used. Municipalities and industries are the major source of organic wastes. Proper implementation of water pollution control and abatement plans will resolve this problem. Current trends indicate difficulties are approaching on the Long Beach peninsula. This involves the conflict between the shellfish industry and waste disposal from the peninsula housing and recreation developments.

The land areas of this coastal subregion are subjected to heavy rains which result in severe erosion and wetness problems if proper land treatment and drainage measures are not employed. The primary developmental alternatives are those which involve storage reservoirs to satisfy the irrigation, flood control, water supply, and flow augmentation requirements.

Flood control programs included consideration of storage, levees, and channel modification. A program of flood plain regulation was included in all areas where flooding occures. Development of over 60 watershed areas is needed to combat erosion, prevent flooding, improve drainage, and provide improved land protection and management.

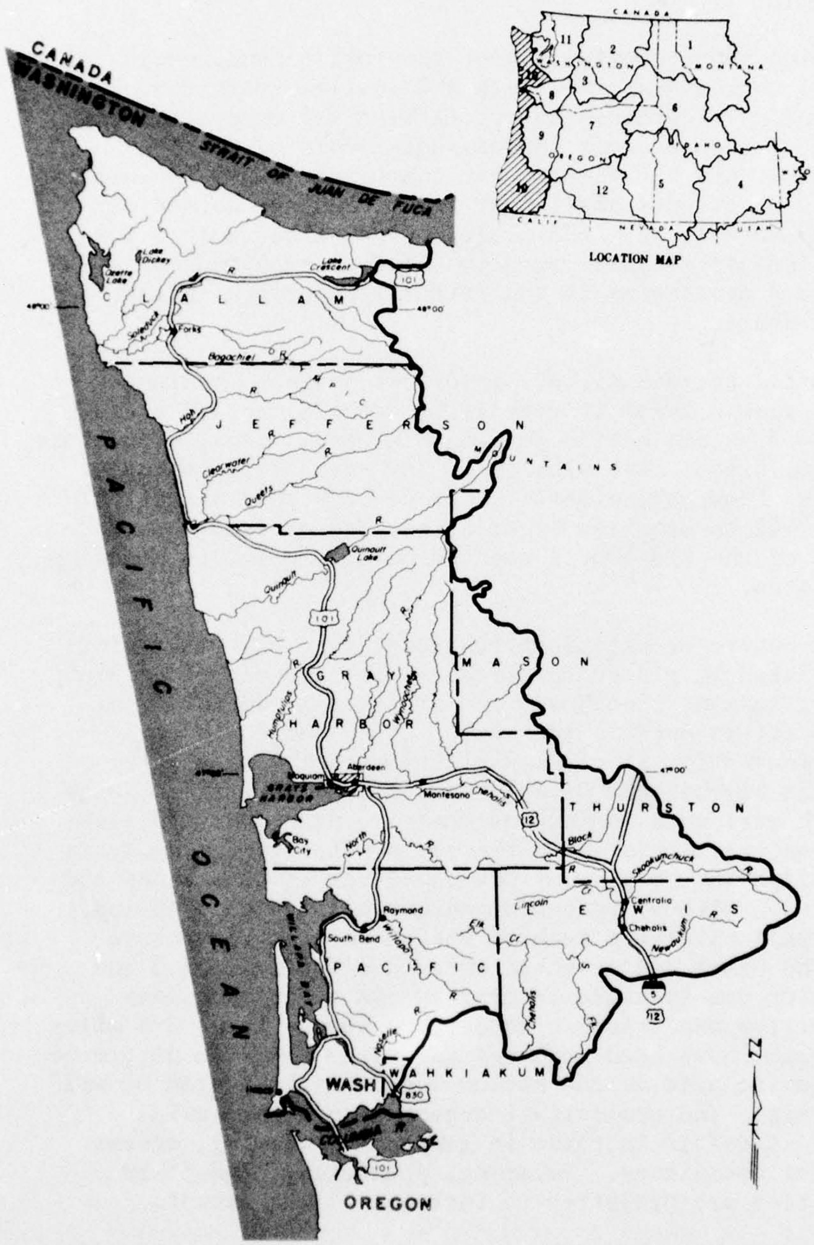
Sixty-one thousand acres of new lands would be irrigated using surface water from new storage and ground waters. As in most areas, surface-water storage alternatives will conflict with fish and wildlife.

Navigation improvements to meet the future needs would include channel improvements for deep and shallow-draft vessels, breakwaters, and mooring areas and facilities for recreation and fishing boats. The deep-draft improvements would be at the entrance to and within the Willapa Bay and Grays Harbor estuaries; breakwaters and additional small boat facilities are needed at other locations such as Neah and Clallam Bays. The sources for municipal and industrial water supplies are generally adequate, but shortages are developing in the latter time period on the Long Beach peninsula.

The coastal streams are all important for both resident and anadromous fish. There is very little development on these streams and the fish are not subjected to numerous dams, diversions, or extensive pollution. One problem is low streamflow in late summer. Planned flow augmentation would relieve this situation. Indian fishing rights acquired by treaties, executive orders, or land purchases of the mid-1930's need to be considered in planning for this subregion.

Lack of public access to recreational land and water areas would be alleviated by planned programs. With the excellent clams, crabs, oysters, salmon, steelhead, and trout, plus bottom fish, this subregion offers much in the way of sport and commercial fishing. The recreation is closely allied with the salt water fishing, but the beaches and Olympic Mountains also attract large numbers of both residents and nonresidents. Large areas adjacent to ocean beaches, particularly on the peninsulas protecting Grays Harbor and Willapa Bay, are being developed for private homes and recreation sites. Without some comprehensive land-use planning, this practice will eliminate much of the shore area for future public use. The beach and seashore areas are not unlimited and future recreation use is bound to overtax the capacity unless positive protective measures are undertaken soon. About 270 miles of coastal streams have been selected for early study to determine which should be included in the national or a state system of wild and scenic rivers. The projected increase in boating would require about a fivefold increase in launching, mooring, access sites, and other facilities. Swimming, picnicking, and other similar activities are projected to increase a like amount.

Electric power generation is projected to have major increases during the later years to supply adjacent populous areas as well as the coastal area. All of the long-range increase is planned to be from thermal-electric sources and totals 9,600 MW



COLUMBIA-NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

COASTAL SUBAREA

COASTAL SUBREGION 10N

FIGURE 24

of additional capacity. Although individual plant sites have not been selected, most new plants will probably be located on the coastline.

The environmental aspects of planning for this subregion are highly important because several areas--primarily the two large estuaries of Willapa Bay and Grays Harbor contain plant and marine life that is vital to fish, shellfish, waterfowl, wildlife, and the general economy of the subregion. The projected economic expansion requires that special care be taken to preserve and enhance the total environment of the coastal area.

Many problems within the coastal subregion are complex and beyond the scope of this study to afford solutions and programs for the framework plan. However, the studies to resolve these problems are discussed later.

1970 to 1980 Program Flood protection for the next decade should include 10 miles of levees on the Chehalis River in the Aberdeen-Cosmopolis area and 9.5 miles of levees in the Chehalis-Centralia area. Damages in the latter area would be reduced by a storage reservoir proposed for irrigation, recreation, low flow augmentation, and other purposes. Land use should be controlled and regulated on all flood plains.

A combination of improved management techniques, land treatment measures, and development of water control structures should be accomplished on cropland, forest land, and rangeland. Accelerated treatment would be required on 17 watersheds.

Irrigation is planned on an additional 39,000 acres of land utilizing both surface- and ground-water supplies. A multiple-purpose storage project on the Chehalis River could supply 50,000 acre-feet of water for 25,000 acres of irrigation in the Chehalis Basin, recreation, fish, and low flow augmentation downstream. Long the coast, multiple-purpose storage in the Willapa Basin would provide 7,000 acre-feet of water to irrigate 5,000 acres of new lands in the Raymond-South Bend vicinity. The Willapa storage would also supply additional water for municipal and industrial uses and augment low flows now detrimental to the fishing. However, the reservoir would inundate a portion of the existing steelhead and salmon grounds.

The early navigation improvements include rehabilitation of the north jetty and channel improvements for deep-draft ships at Grays Harbor and additional moorage spaces, launching ramps, and associated facilities for small boats at Grays Harbor, Neah Bay, Sekiu, La Push, and in the Ilwaco area. The Ilwaco program is currently being initiated by local interests.

Municipal and industrial water supplies require planned system enlargement and acquisition of additional water rights. The plan includes current programs for treatment of municipal and industrial wastes from the Centralia-Chehalis and the Aberdeen-Hoquiam areas. Treatment would conform to the state pollution control and abatement plans.

The fish and wildlife programs are oriented toward preservation of habitat and improved access to allow greater harvest. This includes both fresh and salt water fish and big and upland game. Basic resources would be augmented by additional fish hatcheries and game-bird farms. A study of streams to determine which should be preserved in the interest of fish would also be accomplished.

The plan includes an interdisciplinary study of Willapa Bay to develop a multiple-purpose plan including a hydraulic model for estuarine mangement, environment, navigation, and beach erosion at Cape Shoalwater. Investigations would be made of 270 miles of streams to determine whether they should be included in the State or Federal system of recreation rivers. Some roads would be examined to establish whether inclusion in the scenic and recreational highway system would be warranted.

Long Range Program The intermediate time period includes some new programs as well as the continuation of the early action program.

Flood plain regulation would continue and be continuously updated to conform with the latest results of land-use planning efforts. Two miles of levees are planned at Raymond on the Willapa River.

Land treatment measures and improved land management techniques are required on extensive land areas including 20 small watersheds. Care should be exercised in building structural features to avoid conflicts with the fish and wildlife interests and needs.

Six thousand acres of additional land are planned for irrigation. Two developments could provide the required 10,600 acre-feet, both from ground-water sources. In the Chehalis Basin, 3,700 acres would receive 7,400 acre-feet of ground water, while along the coast another 2,300 acres, mostly in the Humptulips Valley, would receive 3,200 acre-feet of ground water.

Contingent on the results of studies made in the previous time period, erosion at Cape Shoalwater would be controlled, the entrance channel to Willapa Bay would be stabilized and deepened,

and a program for estuarine managment and environmental measures would be implemented. The entrance channel to the Columbia River would be deepened and some interior waterways improved. Dredge disposal should be carefully handled. Additional small boat wet moorages should be provided at Grays Harbor, Neah Bay, Sekiu, and on the lower Columbia River.

Additional water supplies for municipal and industrial uses are required and should be constructed so the supplies and facilities can be expanded as necessary. Consideration should be given to additional supplies for the Long Beach peninsula. Previous studies indicate a multiple-purpose storage site is available on Bear Creek. Water quality and pollution control facilities should also be expanded to meet the projected growth. The state pollution control and abatement plans provide guides toward meeting the study criteria of 90 percent removal of oxidizable organics by the year 2000.

The recreation plan includes the development of over 4,000 acres of recreation land throughout the subregion. This area includes the provision of access to lakes and streams. The plan for this period includes the implementation of the findings which resulted from the studies included in the early action 1980 plan. Also included are studies of wilderness areas, recreation rivers, and the scenic highways.

The fish and wildlife plan for this period includes mostly the continuation of the early action 1970-1980 programs and plan. Three fish hatcheries, 265 miles of stream access improvement, and 110 boat launching lanes are planned for this period. This would call for adopting and conducting additional measures and programs as necessary.

The regional electric power plans include the installation of 1,600 MW of thermal electric capacity on the Washington coast.

Preservation and enhancement of the natural environment would be accomplished by the proper implementation of good land-use plans, especially the seacoast management plans, and by giving full recognition to environmental factors when considering any water, land, industrial, commercial, or recreation developments.

The framework plans for the 2000-2020 period include several implementation programs that would result from earlier study programs.

The flood control and protection needs will be satisfied by flood plain land use regulation or zoning in applicable portions of the flood plains of major streams.

Accelerated treatment for drainage and flood protection is programmed on 25 small watersheds.

Irrigation projections indicate that 16,000 acres of new land must be irrigated between 2000-2020 in order to meet the projected 2020 food and fiber needs. The water needed for this new irrigation will require 38,200 acre-feet, which will be provided form ground water. It is proposed that 11,000 acres in the Grand Mound area of the Chehalis Basin (29,700 acre-feet) and 5,000 acres in the Humptulips Basin (8,500 acre-feet) be developed.

An alternative to this plan would be the development of 16,000 acres of land in the Newaukum area of the Upper Chehalis Basin. Water could be provided by storage from the Alpha dam site, which would provide about 30,000 to 35,000 acre-feet of storage. Preliminary studies indicated the latter alternative the least favorable from economic and environmental standpoints.

The plan calls for expansion of small boat harbors with additional wet moorages to be provided as needed in Willapa Bay, Grays Harbor, Quillayute, Neah Bay, and Sekiu.

The recreation plan for this period includes the continued development of recreation lands and implementing the studies which have been previously conducted. The development of the additional recreation lands includes the provision of access to lakes and streams. Fish and wildlife programs would be continued. Three fish hatcheries and 100 acres of rearing ponds to meet the increased need for fish, plus hatching and rearing facilities for about 9,000 game birds are planned for installation during this period.

Power development during this planning period includes the installation of 8,000 MW of thermal electric power to satisfy regional power needs. Although not sited, it is assumed the plants would be located along the coast and would employ once-through cooling. During this last time period, the most serious problem facing the planners and developers will be siting of powerplants to avoid environmental conflicts.

Puget Sound Subarea (Subregion 11)

The Puget Sound Subarea is the most populous of any in the region, yet within its boundaries are some of the most secluded and rugged areas in the region. With over 2 million people concentrated in a rather narrow belt along the east side of Puget Sound, land in the lower Valleys and benches is intensively developed and subject to many problems. Large water areas and

forested mountainous areas along both the eastern and western boundaries also characterize the subregion. As usual in populous areas, the largest employment is in manufacturing, followed by retail trade and professional services. Agriculture, forest management, and fishing total only about 3 percent of the employment. The subarea is shown on figure 25.

Forest land comprises 76 percent of the land use, cropland 7 percent, rangeland 1 percent, and other land the remaining 16 percent. In addition to approximately 157 square miles of fresh water surface, there are about 2,500 square miles of salt water area in this subregion. This large water area, interspersed with wooded islands separated by narrow channels, makes it one of the most delightful water oriented recreation and boating areas in the world; in fact, Seattle has the highest per capita boat ownership of any area in the United States.

Eleven river basins comprise the major part of the subregion drainage. Flooding by overbank flow of main stem streams occurs on none of the 11 Puget Sound basins. About 87 percent of the flood damage occurs in the Nooksack, Skagit-Samish, and Snohomish Basins. Only two river basins, the Green and Puyallup, have a level of flood protection to the standard required for urban areas. Some publicly and privately owned hydropower dams and reservoirs on the Skagit, Skokomish, Nisqually, and Elwha Rivers provide joint-use and incidental flood storage protection. Levees constructed by local governments, diking and drainage districts, and by Federal agencies provide some protection to urban and agricultural lands, but prevention of flood damages requires additional control measures and implementation of effective flood plain management.

This subregion has serious flooding along with other major land management problems particularly on the croplands in the upstream area. Maintaining the land in a productive capacity while meeting the food and fiber needs will require a coordinated multiple-purpose land and water utilization program. Over 747,000 acres are flooded frequently; of this total 277,000 acres are subject to overbank flooding along main stems of major rivers.

While there are over 2 million acres of land that have wetness problems, only 518,000 acres are expected to have intensive enough use to require drainage.

Nearly all of the land is subject to erosion when not protected. The combined areas of crop, range, forest, and urban land requiring continued protection and rehabilitation measures total nearly 8.5 million acres. It is expected that only 497,000 acres will need rehabilitation measures.

Irrigable lands total 516,000 acres, of which 104,000 are presently irrigated. Due to projected urban and industrial expansion onto agricultural lands, only 223,000 acres are projected for irrigation by 2020. Ground-water pumping, upstream storage, and stream diversions would be needed to meet future requirements. Only the Nooksack, Skagit-Samish, and Elwha-Dungeness Basins have the potential for large project-type development. Irrigation development in the remaining basins is expected to be by individuals.

The greatest increase in municipal and industrial water use is expected to occur in the Seattle, Everett, and Tacoma metropolitan areas. Water supplies for the San Juan Islands are extremely critical and are rapidly becoming so for Whidbey and Camano Islands. The development of new and expansion of existing distribution facilities should provide delivery capacities necessary to meet state ratings for health, fire protection, and peak demands.

Degradation of water quality is caused by waste from municipalities, industries, farms, commercial ships, pleasure craft, and outdoor recreation developments including public areas and private cabins. An estimated 90 percent of wastes discharged into marine waters in 1968 were untreated industrial wastes. Implementation of the (inter- and intra-state) marine and fresh water quality standards would provide for the improvement of water quality.

The port terminal facilities of the basin serve an industrial complex which depends on waterborne commerce to enhance its competitive market position. Significant growth in foreign and domestic commerce is projected with the tonnage forecasted to rise from 42 to 252 million tons by 2020. Navigation expansion can be accomplished by acquiring and developing additional lands for terminal facilities, and for expansion of water transport-oriented industry. However, existing underdeveloped land suitable for these uses is limited and conversion of higher value land will be required. A regional port study would evaluate land needs and alternative uses. Dredging of major channels is required to provide depths satisfactory to the larger vessels projected for the world fleet.

The Puget Sound area has high recreational values. There are many miles of salt water beaches available for public use if adequate access is provided. Numerous streams, lakes, bays, coves, and harbors provide opportunity for development of swimming, camping, picnicking, and boating facilities. Thirty-six streams, or portions thereof, are proposed for study for possible inclusion into a Federal or State system of wild, scenic, or recreation rivers. Updated county recreation inventories and plans are also urgently needed.

COLUMBIA–NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

PUGET SOUND SUBAREA

PUGET SOUND SUBREGION 11

FIGURE 25

Streams flowing into salt water provide excellent habitat for anadromous fish as well as resident species. Nearly every major variety of anadromous fish found in the United States, plus excellent marine and fresh water fish and shellfish are found throughout the Subregion. The 2020 sport fishing demands are projected to increase about 1-1/2 times over the current level, and the commercial, anadromous, and marine fish and shellfish a similar amount, which will require an increase in the basic resource.

The water right of the Skokomish, Squaxin Island, Nisqually, Puyallup, Muckleshoot, Port Madison, Port Gamble, Tulalip, Swinomish, Lower Elwha, and Lummi Indian Reservations must be considered in the planning for the Puget Sound Subregion.

The environmental aspects of the area are outstanding and must be preserved. Preservation of free-flowing streams, scenic and historic areas, maintenance and enhancement of water quality, and coordinated planning to insure proper utilization of shore areas are necessary.

The plan for this basin was formulated by the Puget Sound and Adjacent Waters Task Force for the Comprehensive Study of Water and Related Land Resources, Puget Sound and Adjacent Waters. In some cases minor adjustments were made for this study because of the 1970 base year and variations in definitions. To meet varied and increasing needs the planning process included consideration of all viable alternatives. Numerous upstream storage sites on 20 major rivers were analized to provide flood control, flow augmentation for fish, irrigation and municipal and industrial water supplies, recreation, and power benefits. However, most of the dams and reservoirs were rejected because they inundated areas of high environmental, fish, wildlife, or recreation values or were economically unjustified.

Direct river pumping and treatment, desalinization, diversion, storage, increased ground-water utilization, and improved water yield through various watershed management pracitices were considered as means for satisfying water supply needs of municipalities and industry. Although not fully analyzed, desalinization of water was not considered to be economically competitive with other alternatives at this time. Surface- and ground-water supplies are adequate in most basins to satisfy irrigation and water supply needs through direct diversion. Storage and interbasin diversions were analyzed in those basins which had inadequate water supplies.

Alternatives considered for satisfaction of water quality needs were sewage collection and treatment facilities and minimum streamflows for the assimilation of residual wastes after treatment.

Other alternatives were sewer outfall and dispersal facilities, sludge removal, and waste collection facilities on small boats.

Water supply and water quality are major elements of a study by local governments, scheduled for 1971-1973, leading to a master environmental management program for the Lake Washington, Cedar River, and Green-Duwamish River Basins. The study is sponsored by a consortium of county and city governments, the Municipality of Metropolitan Seattle, sewer districts, the Seattle Water Department, and Puget Sound Governmental Conference; it will employ consultants and have Federal participation. The studies currently underway will result in a comprehensive water resources management plan and a comprehensive water pollution control and abatement plan. Also contemplated are comprehensive plans for air pollution control and abatement, land use allocation, and solid waste management.

Ninety-seven sites along the Puget Sound shoreline are suitable for development as small boat harbors with the capability of accommodating over 115,000 wet moorages. Small boat harbor sites inventoried in this study are sufficient to meet public wet moorage needs to the year 2020 in most basins, with some use of moorage opportunities in adjacent basins possible. In the more populated basins, greater use of dry moorage may be required in the long-range period to satisfy total needs.

The area has only a few sites that have a potential for economic hydroelectric power development as part of multiple-purpose storage projects. There is, however, good potential for single-purpose pumped storage projects and these have been recognized in plan formulation.

Considerable opportunity exists for accomplishing a reduction in the growth of flood damages through flood plain zoning and land use management. Management alternatives include flood proofing and warning and evacuation systems to provide relief to existing as well as future developments located in the flood plain. Flood insurance, while reducing the financial burden to the property owners, requires flood plain zoning by local government and serves as an inducement to regulate future development in the flood plain, thereby helping to stem the growth in flood damages. The construction of levees, channel improvements, stabilization and drainage facilities, small watershed projects and accompanying management practices are measures which provide opportunities to accomplish desired flood control objectives. In only a few basins is there adequate storage capability to satisfy flood control objectives by this means alone. Other structural measures, including levees and diversion channels, are required in addition to management of land use to provide adequate flood protection and damage reduction.

Watershed management alternatives considered for reducing erosion and sedimentation and providing water management included directing future intensive development to suitable land areas. Minimal disruption of the natural environment, land treatment to stabilize soils and vegetative cover, and construction of multiple-purpose small watershed projects are needed for watershed management. An action program has been recommended.

The numerous sites having potential for outdoor recreation activity were identified but specific locations were avoided to reduce possible land speculation. This provided greater flexibility for local and state recreation planners in programming future development of picnicking and camping facilities.

Fish enhancement alternatives include restoration of stream habitat, passage at manmade and natural barriers, and construction of artificial propagation facilities. Wildlife propagation alternatives include bird farms and habitat improvement. Access through easement or acquisition was emphasized as the basic means for increasing sport fishing and hunting opportunities.

The Puget Sound & Adjacent Waters Comprehensive (Type 2) Study was completed in 1971, and has been incorporated into this framework plan. In most of the river basins a plan has been prepared that is responsibe to the planning objectives. However, in the Skagit and Nisqually River Basins some competing demands could not be resolved and major development-nondevelopment alternatives were prepared.

In the Skagit-Samish Basins, alternative A allows full use of storage opportunities to obtain maximum flood control in the Skagit River Basin. This alternative assumes that no portion of the Skagit River or its tributaries would be included in the national wild and scenic rivers system as cited in P.L. 90-452. However, portions of the Skagit River system are to be included for study under a State recreational river system.

Alternative B for the Skagit River Basin is based on the assumption that the entire 165-mile river complex cited in the National Wild and Scenic Rivers Act would be designated in the national wild and scenic rivers system. The assumption is also made that the entire complex would be given a "Recreational River" classification and that nonstorage developments would be compatible with this classification. Completion of a Federal study now being made under the Act is required before a decision can be made in the Skagit Basin.

In the Nisqually River Basin, alternative A would allow for retention of Nisqually Delta in its present relatively natural state and would provide for selective recreation-wildlife and

biotic research use of the Nisqually Delta. Alternative B provides for the utilization of a portion of the delta as a navigation port and related industrial development. A multidiscipline study is recommended to determine which alternative would best meet the short and long-term needs of the area and to resolve questions of compatible use and the desirability of possible joint development of the delta.

The following is a brief summarization of the framework program by time periods. Details may be found in the Comprehensive Study of Water and Related Land Resources, Puget Sound & Adjacent Waters.

<u>1970-1980 Program</u> The plan for the early action period includes seven multiple-purpose storage projects for flood control, low flow augmentation for fish use, municipal and industrial water supply, water quality improvement, power irrigation, and recreation. In addition to flood plain management, 65 miles of levees and 44 miles of channel improvement are projected to help alleviate flood damages. Twenty-five watershed projects in seven basins would be carried out for drainage, erosion control, and flood protection. An increase of 34,000 acres is planned for irrigation. Lands to be irrigated are located in all basins except for San Juan and Whidbey Islands. The water supplies for the irrigable lands would be obtained by direct diversion from ground and surface sources. Eighteen miles of channel would be dredged in the major ports. Approximately 27 small boat harbor projects would provide 17,500 wet moorages. Beach erosion control measures would be constructed at Ediz Hook, Port Angeles. A study of the Nisqually Delta would be completed.

Surface water derived from sources in each basin would be the main supply for eight of the 11 major basins. Whidbey-Camano Islands, Cedar-Green, and Puyallup Basins would depend upon imported water from adjoining basins. Waste disposal into the rivers, their tributaries, and salt water would be controlled to meet State standards. Approximately 17,200 acres including buffer zones are expected to be acquired for recreation and over 600 recreation areas would be developed.

Trout, steelhead, and salmon propagation facilities are planned. These include nine new hatcheries and expansion of seven others, 2 miles of spawning channels, and 55 rearing ponds for cutthroat and steelhead. The plan contains nine artificial passage facilities across both natural and manmade barriers, 510 miles of stream access, 87 access sites to fresh water, and 60 sites on salt water. Cross-sectional stream surveys to determine minimum flows for fish are planned. Fishing piers and jetties located within or near major metropolitan areas are proposed. Acquisition of 19,700

acres of waterfowl habitat and 3,000 acres of upland bird habitat would enhance hunting opportunities. Big game habitat improvements are scheduled on 10,500 acres of land. Programs for increasing the supply of fish and wildlife, especially those designed to develop new or improved management techniques, are contained in the framework plan. Forty-three rivers are recommended for study as possible scenic, recreation, or wild classification.

Long-Range Program During the 1980-2000 period, development of municipal and industrial water supplies by major purveyors and the consolidation of smaller districts into larger regional supply and transmission systems are projected in order to minimize the possible adverse impacts on the environment and water resources which would occur if every water district developed its own supply. An increase of 47,500 acres is projected to be irrigated between 1980 and 2000, including a project-type development in the Skagit-Samish Basins covering 10,000 acres. Dredging 24 miles of channel to the modern deep-draft vessel requirements would be necessary. An additional 72 miles of levees and 3 miles of channel improvements would provide additional flood protection. Fifty-nine watershed projects would be undertaken for drainage and floodwater protection. An additional 5,000 acres of recreation land would be acquired, including salt water beach areas. Camping, picnicking, swimming, and boating facilities would be provided. Thirty-three small boat harbor developments would be undertaken with an additional 37,300 wet moorages provided. The fish and wildlife programs begun prior to 1980 would be continued. Four multiple-purpose storage projects are planned to provide municipal and industrial and irrigation water supply, flow augmentation for fish, and flood control. Hydroelectric power development would comprise 122 megawatts at proposed multiple-purpose storage projects and 120 megawatts by expanding an existing project on the Skagit River.

In the 2000-2020 period, 10 miles of levees and 4 miles of channel improvements are projected. An additional 37,500 acres would be irrigated and 26 watershed projects undertaken. Eighteen thousand acres of recreation lands would be acquired with recreational facilities developed for them. An additional 34 small boat harbors would be constructed providing nearly 45,700 additional wet moorages.

Coastal Zone and Estuaries (Subregions 10N and 11)

The marine shorelands and estuaries of Area D comprise the entire coastline of the State of Washington from the Columbia River on the south to the international boundary on the north, including the shorelines of Puget Sound and adjacent waters. The total length of tidal shoreline in Washington is 2,337 miles including

157 miles facing the open ocean; 252 miles on the estuaries of the Columbia River, Willapa Bay, and Grays Harbor; and 1,928 miles on the waters of Puget Sound, Hood Canal, and the Straits of Juan de Fuca and Georgia, including the shores of 172 significant islands of the San Juan Archipelago. The Washington portion of the Columbia River estuary is included with Area C.

The principal shoreline features are the estuaries of Puget Sound and adjacent waters, Grays Harbor, and Willapa Bay. Wide sandy beaches backed by dunes and grasslands characterize the coastline from the Columbia River to Quinault, about 72 miles, and occur in isolated short stretches in other areas. From the Quinault to Cape Flattery, the shoreline is characterized by narrow rocky beaches with steeply sloping banks. Adjacent lands are heavily forested and numerous rocks dot the ocean surface offshore. The inland shoreline along the Strait of Juan de Fuca is a generally narrow beach backed by steep high bluffs with many outcrops of rock. Extreme indentations characterize the shoreline of Puget Sound and adjacent waters. The greater part of the shoreline is faced by bluffs ranging from 50 to 500 feet in height, composed of glacial till and material deposited during the past ice age. A narrow beach generally occurs at the base of the bluffs, and water depths exceed 50 to 100 feet close to shore. Tidal flats extend for several miles into the sound near several river deltas. Where not cleared away for cities, resorts or farms, dense coniferous forests grow out to the beaches or the edges of high bluffs.

Along the coastline, the 20-fathom depth line runs generally 5 to 10 miles offshore and the 50-fathom line about 15 to 25 miles. The depth in the Strait of Juan de Fuca generally exceeds 50 fathoms. Puget Sound is one of the deepest salt water basin areas in the United States. Depths of 100 to 130 fathoms prevail in the northern section while south of the Tacoma Narrows 50 fathoms is typical. Both Grays Harbor and Willapa Bay are shallow with dredging required to maintain channel depths of 30 and 26 feet, respectively. Large areas in both estuaries are less than 6 feet deep.

Puget Sound and adjacent waters, although technically an estuary, is essentially an inland sea with its own network of estuaries, bays, inlets, and passages. It covers an area of 2,500 square miles of almost landlocked salt water with salinity only slightly less than the open ocean, and is the principal shoreline feature of the area and one of the major estuarine areas of the Nation.

Grays Harbor, the estuary of the Chehalis River, is located about 45 miles north of the mouth of the Columbia River. The estuary broadens gradually from the river channel at Aberdeen to a broad, pear-shaped shallow estuary about 16-1/2 miles long by 12-1/2 miles wide, and covering an area of 97 square miles at mean

lower low tide. The entrance to the ocean is about 2 miles wide and is flanked by jetties which have been in place since the late 19th century.

Willapa Bay is located about half way between Grays Harbor and the Columbia River. It consists of a north-south arm about 19 miles long by 5 miles wide, and an east-west arm about 12 miles long tapering from 5 miles wide at Tokeland to a river channel at South Bend. The surface area ranges from 110 square miles at mean higher high tide to 60 square miles at mean lower low tide. The bay is fed by eight small tributary streams. The entrance to the ocean is at the north end and is about 6 miles wide with a shifting shoal near the center.

Tides have the diurnal inequality typical of the northern Pacific Coast. The mean diurnal tidal range along the coast is about 8 feet and the extreme range is about 14 feet. Tides are magnified in all the major estuaries and extreme tidal ranges are 18 feet in Grays Harbor, 19 feet in Willapa Bay, and as much as 22.5 feet in Puget Sound

Present Situation The area behind the beaches from the Columbia River to the Quinault River is heavily developed with motels, summer homes, and permanent residences. Most of the coastline between Quinault River and Cape Flattery is in Olympic National Park and two Indian reservations. Development is limited and nearly 90 percent of the coastline remains in a natural or near natural condition.

From Cape Flattery to Port Angeles the shoreline is largely undeveloped except for a few isolated fishing villages. Much of the shoreline of the Puget Sound inland waterway is undeveloped because of high banks and difficulty of access to the beaches. Other portions of the shoreline, however, are developed for industrial, residential, and other urban purposes. The major deep-draft ports in Washington are located on Puget Sound. Residences and summer homes dominate portions of the shorelines of many of the San Juan Islands; Vashon, Bainbridge, and Whidbey Islands; Hood Canal; and the west shore of Puget Sound across from Seattle. The shores of Grays Harbor and Willapa Bay are largely undeveloped except at the cities of Aberdeen, Hoquiam, and Cosmopolis on Grays Harbor, and Raymond and South Bend on Willapa Bay.

The quality of marine waters including the open waters of Puget Sound is generally good to excellent, although the long-term effects of wastes discharged into the Sound are not well known. Localized degradation occurs from municipal and industrial pollution and the surface layers of several bays and inlets are significantly polluted. Ships in port also contribute to pollution, as do bilge washing and accidental oil spills on open waterways.

The surface waters of some areas of Puget Sound contain concentrations of sulfite waste liquors. These originate primarily from the sulfite pulp mills at Bellingham, Anacortes, Everett, and Port Angeles. Concentrations diminish as distances from these sites increase. Concentrations greater than 10 ppm can be found throughout most of Bellingham Bay, Possession Sound, and Port Angeles Harbor. Grays Harbor also has been polluted with sulfite waste effluents, phenolics associated with plywood production, and other industrial and municipal wastes. Both Grays Harbor and Willapa Bay, as well as several bays on Puget Sound and adjacent waters, have had some degradation by dredging and deposition of spoil. An ongoing program will insure at least primary treatment of all waters discharging into marine waters including Puget Sound and secondary treatment of waste discharging into rivers and estuaries.

Problems and Needs Coastal and estuarine waters and adjoining lands lend themselves to many uses. However, while each use confers benefits to the user, it often conflicts with use by others. The biggest loss in this piecemeal development has been in the production of fish and wildlife, one of the prime functions of the coastal and estuarine waters. Moreover, while benefits to the developing user are immediate, always identifiable, and most always measurable, damages to other uses, particularly fish and wildlife resources, are often slow to take effect and thus not readily apparent or easily assessable. Other users also have felt creeping losses. The initial occupants along a pristine coastline do not materially affect the esthetics of the area; but as additional homes are built, commercial establishments and tourist facilities are added, and broad highways replace the original access lanes, the area becomes urban in character and loses its esthetic appeal. Homes and tourist facilities have occupied areas more suitable for industrial development while heavy industry with air and water pollution has been established in predominantly recreational areas. Similarly, authorities have not required individual small industries to install elaborate facilities to purify sewage that could dilute harmlessly into a large body of water. However, as additional industries develop, the sewage load becomes too heavy and good water quality is lost.

Damages to fish and wildlife resources result generally from estuarine land developments, development and maintenance of navigation channels, and from water quality degradation. Developments which involve landfill not only remove valuable estuarine lands from production, but also interfere with production in other areas through modification of circulation patterns. Almost all of the estuaries in Washington have been subject to some losses of productive lands through landfill. Lands so withdrawn have been used for port facilities including marinas, industrial sites, vacation home sites, and agricultural purposes. Use of estuarine water for

navigation purposes has adverse effects on fish life through water quality degradation and the effects of dredging. Primary damages from the latter result from the physical disturbance of the estuary bottom while secondary damages may occur from sedimentation and water quality degradation resulting from such disturbance. Damage to fish life from dredging has occurred in Willapa Bay and is reasonably certain to have occurred in Grays Harbor and in some of the other estuaries in the two subregions. Some of the proposals for further channel improvement in Willapa Bay could seriously reduce fish and shellfish production. Pollution has damaged fish and shellfish production in Grays Harbor and several estuaries on Puget Sound and adjacent waters.

Sedimentation has been a problem in almost all estuaries with identifiable damage to fish life occurring in Willapa Bay. Caused by erosion in the watershed, silting or sedimentation of waterways and estuaries occurs as a natural phenomenon. However, man's activities, chiefly in land use, contribute to the silt loads of streams and thereby accelerate the silting process in estuaries. On the other hand, the construction of impoundments on the Columbia River tends to reduce sand and silt discharges which sustain coastal features, principally the Long Beach Peninsula, against wave action. Curtailment of the silt may lead to erosion problems.

Serious erosion is occurring at Cape Shoalwater and Toke Point in Willapa Bay. Elsewhere along the coast and in the Puget Sound area only relatively minor erosion problems exist. The most important is erosion of the shoreline at Titlow Beach near the city of Tacoma. The bank, about 15 to 20 feet high, has been eroding at the rate of 1 foot per year for many years. The beach and backland are part of a city park, and the city desires to control this erosion so that recreation facilities may be developed.

It is estimated that 6,300 acres of marsh and tidelands around Willapa Bay have been reclaimed for agriculture and that industrial and highway uses have withdrawn 300 acres. Plans for conversion to pasture lands would withdraw an additional 6,600 acres.

The construction of lagoon-type housing developments has resulted in the draining, clearing, and filling of fresh water swamps and ponds on the bay side of the Long Beach Peninsula. Apart from the effects on wildlife habitat, these activities tend to modify the fresh water regime along the shoreline and thus affect shellfish production on tidelands. Damages will probably be minor if the development is limited to the shoreline, but a major development involving several hundred acres of tidelands, combined with the other projects reclaiming intertidal areas, could reduce the exchange between the estuary and the ocean during each tidal cycle and thus affect the productivity of the entire estuary. The lands in question have been deeded to private

operators for oyster production. Although the proposed usage is not in accordance with the original intent, the authority of any governmental agency to control the proposed development is limited.

The needs of the coastal zone and estuaries are included in the overall needs for production of certain species of fish and wildlife, for recreational and esthetic values, for water quality and pollution control, for navigation, and for erosion control. Such needs are detailed in the respective appendices and under appropriate headings of the framework plan; therefore, they are not reiterated here.

In addition, there are remaining needs peculiar to the coastal zone and estuaries. The primary need is for an overall plan for appropriate use of shoreside lands and of intertidal areas and for a central planning agency to develop and administer such a plan. By initiative petition and by legislative action, two measures have been prepared for submission to the voters of the State of Washington. Adoption of either measure would provide for such a master plan and establish the State Department of Ecology as the administrating agency.

There is need for research into the many interacting effects of possible developments. For example, what would be the effect of a slight warming of the waters of Puget Sound by several thermal power generators? Shellfish production in some of the Sound bays and estuaries is impaired by cold marine waters. Would warmer water increase this production? Would there be overcompensating losses? Would warming affect the water circulation throughout the Sound? Admirality Inlet is a large mixing zone for the deep waters of the Strait of Juan de Fuca with the surface waters of Puget Sound. The mixed water is lighter than the deep water of the Strait but heavier than the surface water of the Sound. It becomes the surface water of the Strait and the deep water of the Sound. Would significant heating of this mixed water reduce the density differences within the surface waters of the Sound and reduce the circulation of salt water into the Sound? The answer to these and similar questions are needed to allow use of the marine waters without causing havoc to the marine ecosystems.

Area Plans and Programs

The composition of the framework program is contained in table 96. The data are divided by subregions and summarized for the area. The following narrative describes the elements of the plans and programs by function and contains more specific information than the preceding general discussion of planning considerations.

Electric Power

Large quantities of electric power used in Area D are provided on a coordinated basis through a number of interconnected generating and transmission systems. At the same time the power development on the Lewis River, comprising 517 megawatts of installed capacity, serves primarily the Portland areas as will the Trojan nuclear powerplant now under construction.

The existing electric capacity in Area D comprises 2,177 megawatts of hydro and 259 megawatts of thermal generating capacity. Two large thermal electric plants are under construction: a nearly completed coal-fired thermal electric plant near Centralia, which will have an ultimate capacity of 1,400 megawatts and the Trojan nuclear thermal electric plant near Rainier, Oregon, which will have an ultimate capacity of 1,130 megawatts. Construction of the latter was initiated in late 1970; therefore, it is not considered existing but is included in the 1970-1980 program. In addition, the potential for increasing the capacity of the existing hydroelectric plants is 435 megawatts.

The framework plan provides for completing the existing plants to their ultimate capacity during the 1970 to 1980 time period, developing 182 megawatts at multiple-purpose reservoirs, and constructing additional thermal plants.

Planning for future electric power is shown on a regional basis in the Power Appendix. For the framework plan it is assumed that hydroelectric generation will be limited to full development at existing projects plus the potential developments at any multiple-purpose reservoirs included in the plan. Planned additions are shown on table 97. Additional base load needs would be met with thermal generating units and by imports from outside the region. With adequate base load capability, hydroelectric plants will be able to meet peaking requirements through 1990. Beyond that date, other peaking capability, probably thermal-electric or pumped storage, will be needed.

Many factors were considered in developing a plan for locating future thermal electric plants. In general plants would be located as close to load centers as other factors would permit. However, the present public resistance to locating large thermal plants in the area west of the Cascade Range was recognized as was the desire for such plants in the area to the east. This constraint was tempered to avoid additional transmission corridors through the mountains. Consideration also was given to siting plants in areas where adequate water would be available for cooling purposes.

The projected average load for the area as shown in the Power Appendix would be 22,900 megawatts in 2000, and 57,900

Table 96 – Framework Plan Composition, Area D

Purpose or Function	Units	Subregion 8				Subregion 10n				Subregion 11				Area Total			
		1970-1980	1981-2000	2001-2020	Total	1970-1980	1981-2000	2001-2020	Total	1970-1980	1981-2000	2001-2020	Total	1970-1980	1981-2000	2001-2020	Total
Water Development and Control																	
Electric Power																	
Hydro	MW	41	303	0	344	0	0	0	0	60	242	0	302	101	545	0	646
Thermal	MW	1,130	5,870	6,000	13,000	0	1,600	8,000	9,600	1,100	6,900	25,000	33,000	2,230	14,370	39,000	55,600
(Consumptive Use)	1,000 Ac. Ft.	23	78	103	204	0	1	2	3	23	135	415	574	46	214	521	780
						0											
Navigation																	
Locks	Number	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Channels	Miles	0	118	0	118	20	20	0	40	18	24	5	47	38	162	5	205
Breakwaters	Miles	0	0	0	0	3	11	0	14	0	0	0	0	3	11	0	14
Water Quality Control																	
Raw Waste Production 1/	1,000 PE	1,007	2,297	894	4,198	1,765	1,306	894	3,965	2,026	3,717	6,177	11,920	4,798	7,320	7,965	20,083
Waste Removal 1/	1,000 PE	2,652	2,314	805	5,771	1,662	1,469	804	3,935	8,008	1,526	4,442	13,976	12,322	5,309	6,051	23,682
Municipal and Industrial Water																	
Supply	MGD	123	246	142	511	29	47	22	98	394	791	1,148	2,333	546	1,084	1,312	2,942
Municipal	MGD	(14)	(23)	(30)	(67)	(3)	(7)	(7)	(17)	(170)	(265)	(495)	(930)	(187)	(295)	(532)	(1,014)
Industrial	MGD	(109)	(221)	(111)	(441)	(25)	(39)	(14)	(78)	(222)	(520)	(644)	(1,386)	(356)	(780)	(769)	(1,905)
Rural-Domestic	MGD	(0)	(2)	(1)	(3)	(1)	(1)	(1)	(3)	(2)	(6)	(9)	(17)	(3)	(9)	(11)	(23)
Diversions and Withdrawals	1,000 Ac. Ft.	139	274	160	573	33	52	26	111	443	889	1,290	2,622	615	1,215	1,476	3,306
Flood Control																	
Management Areas	Number	6	0	0	6	2	0	0	2	10	0	0	10	18	0	0	18
Major Stream Control																	
(channels and levees)	Miles	61	130	124	315	20	2	0	22	109	75	14	198	190	207	138	535
Single-Purpose Storage	1,000 Ac. Ft.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation																	
New	1,000 Ac.	38	10	30	78	39	6	16	61	34	48	37	119	111	64	83	258
Supplemental	1,000 Ac.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diversions and Withdrawals	1,000 Ac. Ft.	94	22	81	197	74	10	38	122	47	95	77	219	215	127	196	538
Multipurpose Reservoir Storage																	
Capacity	1,000 Ac. Ft.	150	0	35	185	150	0	0	150	702	194	15	911	847	194	50	1,091
Water and Related Land Programs																	
Fish and Wildlife																	
Fish:																	
Habitat Preservation (streams)	Miles	500	150	100	750	300	100	60	460	950	300	200	1,450	1,750	550	360	2,660
Habitat Improvement:																	
Streams	Miles	175	585	583	1,343	90	100	90	280	225	565	390	1,180	490	1,250	1,063	2,803
Lakes	1,000 Ac.	8	11	3	22	2	1	2	5	24	12	18	54	34	24	23	81
Harvest:																	
Stream Access	Miles	309	152	226	687	548	265	400	1,213	510	240	370	1,120	1,367	657	996	3,020
Lake Access Sites	Number	17	8	12	37	9	5	7	21	87	41	63	191	113	54	82	249
Saltwater Area Sites	Number	0	0	0	0	17	8	12	37	60	120	190	370	77	128	202	407
Augmentation of Supply:																	
Hatcheries	Number	4	2	3	9	2	2	3	7	9	17	37	63	15	21	43	79
Rearing Ponds	Acres	175	75	75	325	130	100	100	330	270	170	600	1,040	575	345	775	1,695
Wildlife:																	
Land Acquisition	1,000 Ac.	30	17	21	68	27	15	20	62	80	49	51	180	137	81	92	310
Habitat Improvement	1,000 Ac.	31	45	51	127	31	44	63	138	98	42	139	279	160	131	253	544
Improved Hunting Areas	1,000 Ac.	852	1,137	852	2,841	1,062	1,417	1,062	3,541	1,471	1,961	1,471	4,903	3,385	4,515	3,385	11,285
Augmentation of Supply:																	
Game Birds (1,000's)	Number	12	6	9	27	19	6	9	34	43	20	31	94	74	32	49	155
Outdoor Recreation (Water Related)																	
Recreation Development	1,000 Rec. Days	1,500	2,800	4,800	9,100	3,000	9,100	15,800	27,900	12,400	44,300	84,300	141,000	16,900	56,200	104,900	178,000
Water Surface Use	Acres	11,100	22,600	40,300	74,000	6,200	18,700	33,500	58,400	85,300	244,500	432,000	761,800	102,600	285,800	505,800	894,200
Land Area (rec. facility dev.)	Acres	1,000	1,500	2,800	5,300	2,800	3,500	7,300	13,600	10,600	12,200	24,000	46,800	14,400	17,200	34,100	65,700
Urban Land Acquisition	Acres	200	600	1,400	2,200	0	1,800	4,300	6,100	5,200	9,200	17,600	32,000	5,400	11,600	23,300	40,300
Boat Launch Areas	Lanes	98	193	342	633	40	110	200	350	75	350	600	1,025	213	653	1,142	2,008
Related Land Programs																	
Nonstructural:																	
Erosion and Sediment Control	1,000 Ac.	39	72	70	181	60	105	103	268	106	192	199	497	205	369	372	946
Water Conservation	1,000 Ac.	37	12	32	81	41	9	13	63	42	46	36	124	120	67	81	268
Protection and Management	1,000 Ac.	2,659	2,654	2,123	NA	3,670	3,663	3,650	NA	6,433	6,356	6,209	NA	12,762	12,673	11,982	NA
Water Yield Improvement	1,000 Ac.	0	0	0	0	0	0	0	0	6	54	53	113	6	54	53	113
Structural:																	
Drainage	1,000 Ac.	22	18	22	62	6	9	8	23	33	65	47	145	61	92	77	230
Trib. Stream Control (flood cont.):																	
Bank Stabilization	Miles	181	220	225	626	123	107	85	315	182	198	198	578	486	525	508	1,519
Dikes and Levees	Miles	7	35	30	72	130	172	174	476	37	55	55	147	174	262	259	695
Channel Improvement	Miles	163	259	276	698	595	588	419	1,602	279	393	393	1,065	1,037	1,240	1,088	3,365
Erosion Control Structures	Number	19	15	15	49	259	1,006	1,714	2,979	10	13	16	39	288	1,034	1,745	3,067
Ponds and Small Reservoirs	Number	1	1	4	6	61	194	266	521	598	815	1,055	2,468	660	1,010	1,325	2,995
Ponds and Small Reservoirs	1,000 Ac. Ft.	6	6	3	15	1	0	1	2	4	5	5	14	11	11	9	31
Studies																	
Coastal Zone and Estuaries																	
Estuarine Management Areas	Number	0	0	0	0	6	0	0	6	1	0	0	1	7	0	0	7
Estuarine Management Areas	1,000 Ac.	0	0	0	0	133	0	0	133	1,600	0	0	1,600	1,733	0	0	1,733
Beach Management	Miles	0	0	0	0	97	0	0	97	130	122	0	252	227	122	0	349
Beach Stabilization	Miles	0	0	0	0	5	24	0	29	3	66	0	69	7	91	0	98
River Basin	Number	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1
Watersheds	Number	37	7	0	44	37	25	0	62	84	26	0	110	158	58	0	216
Special Studies:																	
Preservation of Streams	Miles	478	0	0	478	270	0	0	270	1,006	0	0	1,006	1,754	0	0	1,754
Scenic Roads	Miles	394	0	0	394	260	0	0	260	750	0	0	750	1,404	0	0	1,404
Roadless Areas	1,000 Ac.	35	0	0	35	1	0	0	1	578	0	0	578	614	0	0	614
Minimum Flows	Number													1	0	0	1
Other	Number													0	0	0	0

1/ Includes municipal, industrial, and recreation uses.

Table 97 - Planned Additions to Existing Projects, Area D

Project	Additional Capacity		
	1970-1980	1981-2000	2001-2020
	(mega atts)		
Subregion 8			
Merwin	0	45	0
Yale	0	108	0
Mayfield	41	0	0
Mossyrock	0	150	0
Total	41	303	0
Subregion 10N			
None	0	0	0
Subregion 11			
Diablo	0	120	0
North Fork Snoqualmie	60	0	0
Nooksack Falls	0	26	0
Lower Sauk	0	96	0
Total	60	242	0
Area D	101	545	0

Table 98 - Phasing of Power Installations, Area D1/

Subregion	1970			1971-1980		1981-2000		2001-2020	
	Existing	Under Const.	Total	Added	Total	Added	Total2/	Added	Total
				(installation in megawatts)					
Subregion 8									
Hydro	966	0	966	41	1,007	300	1,300	0	1,300
Thermal	27	0	27	1,130	1,157	5,870	7,000	6,000	13,000
Subregion 10N									
Hydro	0	0	0	0	0	0	0	0	0
Thermal	13	1,400	1,413	0	1,413	1,600	3,000	8,000	11,000
Subregion 11									
Hydro	1,176	0	1,176	60	1,236	200	1,400	0	1,400
Thermal	220	0	220	1,100	1,320	6,900	8,000	25,000	33,000
Area D									
Hydro	2,142	0	2,142	101	2,243	500	2,700	0	2,700
Thermal	260	1,400	1,660	2,230	3,890	14,370	18,000	39,000	57,000
Total	2,402	1,400	3,802	2,331	6,133	14,870	20,700	39,000	59,700

1/ Nameplate ratings.
2/ After 1980, all existing small thermal plants would be retired, hydro capacities rounded to nearest 100 mw by subregion.

megawatts in 2020. Projected peak requirements would be 37,100 and 93,700 megawatts. A maximum of 22,000 megawatts would be transmitted from the area east of the Cascade Range. The balance of the area needs would be met by adding generating capacity as shown in table 98.

Several alternative methods for cooling thermal electric power installations are discussed in the Power Appendix. In Area D it appears that the most probable types are evaporative cooling towers and direct, once-through cooling. Cooling towers are included in the two plants under construction and would be used at all future plants using fresh water. Consumptive water requirements would vary from 17,000 acre-feet per 1,000 megawatts per year for modern fossil-fuel and future nuclear plants to 21,000 acre-feet for present-day nuclear plants. Direct, once-through cooling is not an acceptable alternative where cooling waters would be returned to a lake or stream in view of water quality standards. However, the cold salt water of the area has a tremendous cooling potential. It is believed that several plants could be located on salt water without seriously disturbing the ecosystems if care is exercised to insure rapid dispersal of heated effluents. Future studies would make such determinations. Direct cooling would require 1,185 to 1,620 cfs of salt water with a 20°F. temperature rise, and 0.4 cfs of fresh water per 1,000 megawatts and would introduce 5 to 7 billion BTU per hour into the waterway. Cooling water requirements assuming evaporative cooling towers except along the coast are shown in table 99.

Table 99 Planned Thermal Power and Water Requirements, Area D

Subregion	Thermal Installation 1/			Annual Water Requirements 2/		
	1980	2000	2020	1980	2000	2020
		(megawatts)			(1,000 ac-ft)	
8	1,130	7,000	13,000	23	101	204
10N	1,400	3,000	11,000	24	25	26
11	1,100	8,000	33,000	23	158	574
Area B	3,630	18,000	57,000	70	284	804

1/ Excludes existing small plants.
2/ Fresh water only.

Detailed studies of means to meet peaking needs beyond 1990 have not been made. Recent improvements in reversible pump-turbines have created considerable interest in pumped storage especially in areas where reservoirs with high heads and short conduits are available. The present outlook is that pumped storage will be the most satisfactory means of meeting peaking requirements in excess of the capacity of the conventional hydro system. To minimize transmission costs and problems, the pumped storage projects should be located as close as possible to load centers which would mean that several plants would be located in

the area. At the same time, full recognition must be given to preservation of fish and wildlife habitat. A map reconnaissance site inventory, shown in Appendix XV, listed nearly 150 potential sites capable of daily/weekly operation that would develop 1,000 megawatts or more. It appears that future peaking needs could be met in this area, although much more study will be needed, especially to determine the environmental impacts of each prospective project.

Navigation

Waterborne commerce amounts to 80 million tons annually comprising 41 million tons of foreign and domestic coastwise and 39 million tons internal, including commerce moving on the lower Columbia River to and from the Port of Portland, Oregon. This commerce is projected to increase to 194 million tons annually foreign and domestic coastwise, and 141 million tons internal by 2020, table 100. The increases are expected to be handled by more and larger, faster ships and more efficient cargo handling facilities. It is estimated that 88,000 recreational boats use the navigable waters of the area and the number will increase to 472,000 by 2020. Use of other waters is expected to increase by over 800,000 boats.

Table 100 - Prospective Waterborne Commerce, Area D

	1968		1980		2000		2020	
Sub-region	In-ternal	Foreign & Coast-wise	In-ternal	Foreign & Coast-wise	In-ternal	Foreign & Coast-wise	In-ternal	Foreign & Coast-wise
8	11,500	16,800	11,600	29,400	14,800	43,600	20,100	57,500
10N	2,100	2,000	2,100	2,400	2,100	2,500	2,100	2,800
11	25,200	22,300	31,800	35,000	57,800	67,700	118,400	133,600
Area D	38,800	41,100	45,500	66,800	74,700	113,800	140,600	193,900

Facilities are generally adequate for existing navigation although ships are delayed to some degree by inadequate channel depths at Grays Harbor and Willapa Bay and to a lesser degree at several harbors at Puget Sound. Channel widths limit ship sizes in several Puget Sound waterways, including the Duwamish at Seattle. The plan provides for additional small boat moorages especially adjacent to popular fishing areas. Programs also provide for deeper channels to accommodate larger ships, additional and more efficient cargo handling facilities, and additional moorage and launching facilities for small boats.

During the early period, the framework plan proposes that the following navigation improvements would be made.

(1) The entrance and interior channels at Grays Harbor would be deepened to approximately 45 and 35 feet respectively at mean lower low water and the north jetty would be rehabilitated.

(2) In the Puget Sound area, 13 existing channels would be deepened and one new channel would be dredged for a total length of 18 miles. Channel depths would be as shown in table 101.

(3) Port and terminal facilities would be expanded through the competitive efforts of port authorities and private industry to each improve its own facilities according to its proportion of the total trade. These efforts are expected to keep total facility capabilities ahead of actual needs.

(4) Additional small boat moorages would be constructed at Ilwaco, Westport, and Ocean Shores on Grays Harbor, Neah Bay, Sekiu, La Push, and at 27 locations on Puget Sound waters. These would require cooperative efforts by public agencies and private operators and would provide 20,000 moorage spaces. Additional facilities would be provided by private operators at locations where development costs would be lower. A total of 40 new launching ramps would provide the equivalent of 200 single lanes. In the Puget Sound area, launching facilities would be integrated with moorage basins.

(5) A study of the lower Columbia River would be completed to determine proper disposal of dredge spoil and assess the need for increased channel depths.

(6) A regional harbor study would be made.

From 1980 to 2000, the framework plan includes the following:

(1) The Columbia River channel from Portland-Vancouver to the ocean would be dredged to a deeper depth. Determination of depth is beyond the scope of this study, but a depth of 45 to 50 feet at low water with 15 to 20 feet additional depth at the mouth appears reasonable.

(2) The channels at Willapa Bay would be improved, and the entrance would be stabilized.

(3) Channels at Anacortes, Bellingham, Everett, Tacoma, Olympia, would be further deepened. The potential channel development at Nisqually Delta has not been included in the plan elements because of the need for additional studies to resolve developmental and environmental differences.

(4) Expansion of port and terminal facilities would be continued.

(5) Additional small-boat moorages to accommodate 40,000 boats and 310 additional lanes of launching ramps would be constructed.

From 2000 to 2020, further improvements for commercial navigation would comprise minor deepening of access channels and continued improvement of port and terminal facilities. To meet the needs of recreational boats, moorage basins with a total capacity of 53,000 spaces would be provided in dry storage adjacent to the water. Nearly 600 additional lanes of launching ramps would be constructed. Table 101 summarizes the major improvements by time period.

Table 101 - Planned Navigation Channel Improvements, Area D

Port and Channel	Length (miles)	Depth (feet) Exist	1980	2000	2020
Columbia River[1/] Entrance	4	48	-	60-75	-
Interior	114	40	-	45-50	-
Willapa Bay-Entrance	-	26	-	30	-
Interior	20	24	-	30	-
Grays Harbor-Entrance	-	30	45	-	-
Interior	20	30	35	-	-
Port Angeles	-	30	46	-	-
Anacortes-Fidalgo Bay	1	-	32	40	46
Padilla Bay	3.5	-	-	46	54
Guemes Chnl.	-	50	54	78	-
Bellingham-Whatcom Creek	1	30	40	46	-
Nooksack Delta	1	-	-	46	-
Everett-Lower Snohomish	3.5	8-15	32	46	-
Upper Snohomish	7	8	-	20	-
East Waterway	0.5	30	46	78	-
Seattle-East & West Waterway	1.3	34	54	-	-
Duwamish below 1st	1.0	30	46	-	-
Duwamish 1st to 8th	2.5	20	32	-	-
Tacoma-Hylebos	2.6	30	46	78	-
Port Industrial	2.0	35	52	106	-
Sitcum	0.6	25-40	78	-	-
Olympia-Existing Waterway	1.8	30	40	46	-
East side of harbor	-	0-5	-	46	-

1/ Includes Willamette River, Portland Harbor.

Water Quality Control

Although other elements are also necessary, installation of adequate waste treatment facilities is a prerequisite for achieving desired water quality objectives in Area D. For study purposes, it has been assumed that in Subregions 8 and 10N treatment of all municipal and industrial wastes would remove 85 percent of organic wastes by 1980, and 90 percent by 2000 and 2020. In Subregion 11,

residual wastes following treatment were computed in the Type 2 study using secondary treatment efficiencies of 85 percent for 1980 and 2000, and 90 percent for 2020. Primary treatment efficiencies on discharges to certain marine waters were assumed to be 35 percent for 1980 and 2000, and 40 percent for 2020 to reflect more advanced equipment and processes. Along with these treatment levels, the plan provides for extending sewer lines to serve a greater portion of the population and for separation of storm and sanitary sewers. Tertiary treatment would be provided for sewage flowing into certain lakes. Table 102 shows projected levels of raw and treated wastes.

Table 102 - Projected Raw Waste Production and Residual Discharge with Planned Treatment, Area D

	1970		1980		2000		2020	
	Raw	Disch.1/	Raw	Disch.	Raw	Disch.	Raw	Disch.
				(1,000 p.e.)				
Subregion 8								
Municipal	134	41	196	29	307	31	448	45
Industrial	3,776	2,341	4,709	706	6,861	686	7,548	755
Recreation	31	5	43	7	77	8	143	14
Total	3,941	2,387	4,948	742	7,245	725	8,139	814
Subregion 10N								
Municipal	82	18	90	13	114	11	138	14
Industrial	3,910	743	5,630	845	6,791	679	7,454	745
Recreation	101	15	138	21	259	26	466	47
Total	4,093	776	5,858	879	7,164	716	8,058	806
Subregion 11								
Municipal	1,929	1,004	3,183	1,871	5,118	3,085	8,208	4,520
Industrial	14,334	10,608	15,008	3,740	16,454	4,588	18,886	4,763
Recreation	263	131	361	150	697	279	1,352	404
Total	16,526	11,743	18,553	5,761	22,269	7,952	28,446	9,687
Area D								
Municipal	2,145	1,063	3,469	1,913	5,539	3,127	8,794	4,579
Industrial	22,020	13,692	25,347	5,291	30,106	5,953	33,888	6,263
Recreation	395	151	542	178	1,033	313	1,961	465
Total	24,560	14,906	29,358	7,382	36,678	9,393	44,643	11,307

1/ Estimated from 1965 data.

Source: Appendix XII, Water Quality and Pollution Control, modified data from comprehensive water and related land resource study of Puget Sound & Adjacent Waters (Subregion 11).

In addition to the collection and treatment of wastes, the following features of the framework plan would assist in maintaining and improving water quality.

Recreation developments would include adequate provisions for collection and treatment of wastes. Boats would be required to hold wastes for discharge on shore or on the open ocean.

Individual rural-domestic sewer systems would be required to meet standards with regard to contamination of waterways.

Land treatment measures and improved irrigation efficiencies would not only improve agricultural production but also would curtail contamination of waterways from runoff and return flows. Dairy and feedlot cattle holding areas would be fenced to prevent

stream contamination and bank erosion. Wastes would be collected where necessary for return to land.

Strict control would be maintained on mining, dredging, construction, and other activities which cause pollution or otherwise degrade the quality of water. Particular attention would be paid to prevention of petroleum spills and dumping of ship bilges in restricted waters.

Present streamflows during the summer low water season exceed flow requirements for treated waste assimilation in most rivers. However, the plan provides that the effluent from the Renton secondary sewage treatment plant would be diverted from the Green-Duwamish River directly into Puget Sound if necessary to maintain the quality of the river. A study would be made of the entire Lake Washington system to determine a means of handling increasing loads of nutrients as urban buildup continues. In addition, lockages between Lake Washington and Puget Sound threaten salinity intrusion into the lake. These problems are compounded by the proposal by the city of Seattle to increase its diversions from the Cedar River to meet municipal and industrial demands. Current studies of these problems are briefly described below:

A 2-year Water Resources Management Study is planned for the Cedar and Green River Basins. The purpose of this study is to provide a plan that, through the cooperative efforts of the Seattle Water Department and the Municipality of Metropolitan Seattle (METRO), will insure the best utilization of the total water resources available to the two river basins in 1970, and through the years 1985 and 2000. The study will not only establish a plan to meet the future water demands in the area, it will also furnish vital information to another program being directed by the River Basins Coordinating Committee (RIBCO), a consortium of Federal, State, and local agencies in the Seattle-King County area. The RIBCO program is a water pollution control and abatement plan study for the Cedar and Green Basins and is scheduled to begin July 1971, and be completed June 1973.

One of the more important features of the water quality plan is provision for continuous monitoring to insure that all measures are functioning. A basic network has been set up for both fresh water areas and the marine waters of Puget Sound and other estuaries. Some expansion is planned and readjustments will be made in the future to conform to waste source changes.

Municipal and Industrial Water Supply

Water resources generally are available to meet the demands of municipal, industrial, and rural-domestic water supply. However, local difficulties in obtaining water undoubtedly will develop. As municipal systems are expanded and replaced in the future, communities will have to shift to complete treatment of their raw surface-water supplies. Where quality of ground water cannot be controlled, treatment also will be required. The framework plan includes measures for conveyance to the point of distribution and treatment as required to bring the quality of the projected water demands to interstate standards. Table 103 shows the projected amounts by use and time.

Table 103 - Planned Municipal & Industrial Water Supply, Area D

Sub-region	Water Use	1970	1980	2000	2020
			(mgd)		
8	Municipal	33.3	47.1	70.4	100.4
	Vancouver-Camas Service Area	(18.9)	(27.4)	(41.7)	(60.4)
	Longview-Kelso Service Area	(9.9)	(14.0)	(20.3)	(29.5)
	Other	(4.5)	(5.7)	(8.4)	(10.5)
	Industrial	409.1	518.4	739.2	849.5
	Rural-Domestic	8.7	8.8	10.7	12.2
	Total	451.1	574.3	820.3	962.1
10N	Municipal	13.7	17.2	23.8	31.3
	Aberdeen Service Area	(5.9)	(7.4)	(9.6)	(12.1)
	Chehalis-Centralia Service Area	(2.9)	(3.6)	(4.6)	(5.8)
	Other	(4.9)	(6.2)	(9.6)	(13.4)
	Industrial	110.9	135.6	174.9	188.8
	Rural-Domestic	3.3	3.8	5.0	6.2
	Total	127.9	156.6	203.7	226.3
11	Municipal	302.7	472.0	736.3	1,231.5
	Bellingham Service Area	(9.4)	(10.5)	(15.8)	(23.1)
	Everett Service Area	(24.8)	(34.2)	(52.5)	(104.0)
	Seattle Service Area	(135.3)	(222.0)	(297.0)	(475.0)
	Tacoma Service Area	(30.8)	(47.6)	(88.9)	(168.0)
	Olympia Service Area	(5.4)	(10.7)	(21.6)	(40.0)
	Bremerton Service Area	(8.8)	(13.3)	(24.4)	(39.0)
	Other	(88.2)	(133.7)	(236.1)	(382.4)
	Industrial	543.3	765.9	1,285.5	1,930.6
	Rural-Domestic	9.8	12.6	18.6	26.6
	Total	855.8	1,250.5	2,040.4	3,188.7
Area D	Municipal	349.7	536.3	830.5	1,363.2
	Industrial	1,063.3	1,419.9	2,199.6	2,968.9
	Rural-Domestic	21.8	25.2	34.3	45.0
	Total	1,434.8	1,981.4	3,064.4	4,377.1

Source: Appendix XI, Municipal & Industrial Water Supply.

Municipal The majority of the population, about 89 percent, is served by municipal water systems. In most areas, municipal systems draw from surface-water sources, but in Subregion 8 about 60 percent of the municipal supplies come from ground water. In other subregions ground water is used to supplement surface-water supplies. Supplies are generally adequate for present requirements, except at Rainier, Oregon, where summer water shortages occur. Future water needs in the Chehalis-Centralia service area are expected to exceed present supplies, but other sources are available, the most readily obtainable being the Chehalis River. Some of the basins in Subregion 11 will have shortages which will require study of interbasin transfers, greater utilization of ground water, and possibly even desalinization.

Ground-water supplies normally do not require treatment and most surface waters are of satisfactory quality except for excessive turbidity following heavy rains. Disinfection is required on surface and mixed systems, and it is expected that in the future all supplies will receive at least disinfection and surface supplies will receive complete treatment.

Industrial Industries are generally located where sufficient water of suitable quality is available, and many industries obtain all or part of their industrial supplies from municipal systems. Municipalities are expected to adequately develop new sources as needs arise and should have no difficulty in supplying the industrial water demands on their systems.

Rural Domestic No widespread problems are foreseen in satisfying future rural-domestic water supply needs. Supplies are obtained from wells, springs, or headwater stream sources and are generally adequate. Some localized shortages occur during the summer months. Some quality problems have occurred and others are expected. Sea water has encroached into aquifers on Whidbey Island and other shoreline areas and can be expected to increase with greater use of the aquifer. Bacterial contamination can also be expected as suburban expansion continues. These problems will probably lend themselves to use of surface water with necessary treatment plants and distribution systems.

Summary Except for possible shortages in small localized areas, no problems are expected in meeting future municipal, industrial, and rural-domestic requirements.

Flood Control

Damages from flooding on major streams are projected to increase from the present annual level of $9,722,000 to $45,275,000 by 2020. Nonstructural measures, except land treatment, would reduce the impact of floods without controlling the floodwaters. The plan provides for flood plain regulations, via local zoning ordinances or other means, to control land use and development along about 35 of the major streams in western Washington. Structural measures and land treatment would reduce the extent and frequency of flooding.

Nonstructural Measures The distribution of flood plain information and furnishing of technical assistance to local government units would be accelerated by Federal and State agencies. This service will promote establishment of local zoning regulations to control the increase in flood-damage potential. The framework plan assumes that effective zoning regulations will be enacted during the early time frame in all critical areas and will be enforced as needed through the balance of the forecast period.

Improved flood forecasting techniques are expected to give earlier warnings of impending disastrous floods and facilitate emergency floodproofing and evacuation. Major floods on the lower Columbia River can be predicted several days to several weeks in advance. Throughout the balance of the area, forecasts more than 2 to 3 days in advance of flooding must rely heavily on weather predictions and are not as reliable as on the Columbia. Significant improvements in these areas will be contingent on improvements in weather forecasting techniques.

Structural Measures Structural measures included in the framework plan for flood protection include some 949,300 acre-feet of flood control and joint use storage and 540 miles of levees, bank protection, and channel improvement work on major streams. Additional structural measures on minor streams are included in the discussion on land treatment and watershed protection.

During the early time frame, the plan provides for 655.3 thousand acre-feet of joint-use storage which would operate as needed for flood control on a forecast basis. In addition, 155 thousand acre-feet of single-purpose storage at two existing power reservoirs in Subregion 11 would be reallocated to joint use and made available for flood control. Storage amounting to 11 thousand acre-feet in new farm ponds and small reservoirs also would provide incidental flood control. An alternative development in Subregion 8, which would use offstream storage, ground water, or the Columbia River for irrigation supplies in lieu of 150 thousand

acre-feet of storage on Salmon Creek would reduce the planned incidental storage for flood control. Table 104 lists the storage by basin and time period.

Local protection projects would comprise 106 miles of new and improved levees, 35 miles of revetments to protect existing and proposed levees, and 49 miles of channel rectification. Reconstruction of levees back from the streambanks to provide greater channel capacity is included in the channel rectification.

During the middle time frame, the plan provides for 194 thousand acre-feet of joint-use storage, which would be available for flood control, and for 11 thousand acre-feet of storage in farm ponds and small reservoirs. Local protection projects would include 124 miles of levees, 70 miles of revetments, and 13 miles of channel rectification. As during the earlier time period, the levee work would include both new levees and reconstruction of existing levees, the revetments would largely be to protect levees, and the channel rectification would include setback levees to provide additional flow capacity. An alternative proposal in the Puget Sound area would maintain the lower Sauk River, a tributary of the Skagit, in its present free-flowing state in lieu of 134 thousand acre-feet of joint-use storage. With this alternative, higher and stronger levees and greater channel capacities would be required along the lower Skagit. Another alternative in the Puget Sound area would provide a port-industrial complex on the delta of the Nisqually River. This alternative would require 3 miles of levees and 1 mile of channel improvement, which are not included in the above totals.

During the final time period, 50 thousand acre-feet of multiple-use storage would be added and farm ponds and small reservoirs would contribute 9 thousand acre-feet. Local protection projects would include 63 miles of levees, 70 miles of revetments, and 3 miles of channel improvements. Table 104 summarizes the flood control works for the area by location, type of work, and time period.

The main-stream storage projects cited would provide a high degree of control in the reaches immediately downstream from the reservoirs. However, the control would diminish farther downstream and substantial damages would remain along all major streams. These damages would be further reduced by the planned levee and channel program. Nonstructural measures would prevent unwarranted growth of damage potential and provide warnings of impending serious flooding.

Table 104 - Planned Local Flood Protective Works, Area D

Stream	Location	Type of Work
	1970 to 1980	
Nooksack	Ferndale	Levees
Skagit	Nookachamps Creek Area	Levee
Skagit	Burlington downstream	Improve levee and channel
Skagit	Sedro Wooley downstream	Levee and Avon bypass
Stillaguamish	Stanwood	Levees
Snohomish	Mouth	Modify floodway
Snohomish	Mile 10 to mile 18.5	Set back levees
Green	Auburn downstream	Improve levee and channel
Puyallup	Orting	Levee
Dosewallips	Dosewallips State Park	Levees
Columbia	Lower River	New and improved levees
Columbia	Lower River	Revetments to protect levees
Cowlitz	Below Mayfield Dam	Levees, channel clearing
Chehalis-Skookumchuck	Centralia	Levees
Chehalis	Aberdeen-Cosmopolis	Levees
	1980 to 2000	
Nooksack	Lynden	Levees
Nooksack	Lynden to Everson	Levees
Sumas	Sumas	Levees
Skagit	Sedro Wooley	Levees
Skagit	Hamilton	Levees
Stillaguamish	Silvana to Arlington	Improve levee and floodway
Snohomish	Mile 3 to mile 6.3	Improve floodway
Snohomish	(Carnation, Gold Bar)	
"	(Skykomish, Sultan)	Improve levees
"	(Monroe)	
"	S F Tolt River	Modify Outlet to Reservoir
Cedar	River mile 4.5 to 17.5	Levees and channel improvement
Puyallup	South Prairie	Levee
Nisqually	Nisqually Delta	Levees
Big Quilcene	Quilcene	Levee
Skokomish	Mile 0 - mile 10	Levees
Columbia	Lower River	New and improved levees
Columbia	Lower River	Revetment to protect levees
Cowlitz	Packwood	Levees
Willapa	Raymond	Levees
	2000 to 2020	
Snohomish	Mile 6.3 to Mile 10	Improve floodway
Elwha	Lower reach	Levee
Dungeness	Lower reach	Set back levees
Columbia	Lower River	New and improved levees
Columbia	Lower River	Revetment to protect levees

Irrigation

Projections indicate that 400,000 acres of land need to be irrigated by 2020, an increase of 258,000 acres. Approximately 30 percent of these lands are located in Subregion 8, 24 percent in Subregion 10N, and 46 percent in Subregion 11. About 3,000 acres or 1 percent of the total new lands are located along the Oregon side of the Columbia River.

Irrigation diversions as shown in table 105 indicate that an increase of 538,000 acre-feet is required to meet the new water needs. About 181,000 acre-feet are expected to be derived from ground-water sources and 357,000 acre-feet from surface water. New storage of 274,000 acre-feet would be necessary. All presently irrigated land has sufficient water, therefore no supplemental supplies are required.

Approximately 10 percent of the irrigation development is expected to be through private initiative, both individually and by small groups and the remainder through Federal and federally assisted projects. Table 105 shows the irrigation requirements in terms of land and water.

In the Lewis and Cowlitz Basins nearly all irrigation development would be located along the lower river valleys. About 150,000 acre-feet of storage would be needed in the Lewis River-Salmon Creek drainages and 35,000 in Cowlitz. The water supplies for other lands would be obtained by pumping from ground water or direct diversion from tributary streams and the Columbia River.

Acreages projected for irrigation in the Chehalis River Basin would receive their water supplies from a 60,000 acre-foot reservoir, tributary stream diversion and ground-water pumping.

A 90,000 acre-foot multiple-purpose reservoir in the lower Willapa River Basin would be the source of supply for 5,000 acres of projected irrigable lands.

The remaining potentially irrigable lands are located in small parcels along the coastal drainages and would obtain their water supplies from local ground-water aquifers.

In the Puget Sound Subregion, future irrigation development is projected to be accomplished primarily by individual farm developments except for parts of the Nooksack and Skagit-Samish River Basins where project-type developments are projected. Water supplies for the individual farm developments would be obtained primarily from ground water supplemented by surface diversions from the major rivers and tributary streams. All the r[illegible]asins

Table 105 - Planned Irrigation Development, Diversions, and Depletions, Area D

Location or Basin	1970-1980 Acreage New (1,000 ac)	1970-1980 Acreage Suppl. (1,000 ac)	1970-1980 Diversion (1,000 ac-ft)	1970-1980 Depletion (1,000 ac-ft)	1980-2000 Acreage New (1,000 ac)	1980-2000 Acreage Suppl. (1,000 ac)	1980-2000 Diversion (1,000 ac-ft)	1980-2000 Depletion (1,000 ac-ft)	2000-2020 Acreage New (1,000 ac)	2000-2020 Acreage Suppl. (1,000 ac)	2000-2020 Diversion (1,000 ac-ft)	2000-2020 Depletion (1,000 ac-ft)	1970-2020 Acreage New (1,000 ac)	1970-2020 Acreage Suppl. (1,000 ac)	1970-2020 Diversion (1,000 ac-ft)	1970-2020 Depletion (1,000 ac-ft)
Subregion 8																
Lewis River	35	-	87	59	10	-	22	15	0	-	0	0	45	-	109	74
Cowlitz River	0	-	0	0	0	-	0	0	30	-	81	54	30	-	81	54
Columbia River (Oregon)	3	-	7	4	0	-	0	0	0	-	0	0	3	-	7	4
Total	38	-	94	63	10	-	22	15	30	-	81	54	78	-	197	132
Subregion 10N																
Chehalis River	31	-	62	44	4	-	7	5	11	-	30	20	46	-	99	69
Willapa	5	-	7	4	0	-	0	0	0	-	0	0	5	-	7	4
Coastal Drainages	3	-	5	3	2	-	3	2	5	-	8	5	10	-	16	10
Total	39	-	74	51	6	-	10	7	16	-	38	25	61	-	122	83
Subregion 11																
Nooksack-Sumas	14	-	33	25	20	-	38	26	0	-	0	0	34	-	71	51
Skagit-Samish	7	-	13	13	10	-	19	18	25	-	48	47	42	-	80	78
Stillaguamish	3	-	6	4	4	-	8	5	0	-	0	0	7	-	14	9
Snohomish	1	-	2	1	4	-	7	5	1	-	3	2	6	-	12	8
Cedar-Green	-1 1/	-	-2 1/	-1 1/	-1 1/	-	-2 1/	-1 1/	0	-	0	0	-2 1/	-	-4 1/	-2 1/
Puyallup	2	-	5	3	5	-	12	8	3	-	6	4	10	-	23	15
Nisqually-Deschutes	2	-	5	3	5	-	12	8	8	-	19	12	15	-	36	23
West Sound	0	-	0	0	1	-	1	1	0	-	1	1	1	-	2	2
Elwha-Dungeness	6	-	-15 1/	-15 1/	0	-	0	0	0	-		0	6	-	-15 1/	-15 1/
Total	34	-	47	33	48	-	95	70	37	-	77	66	119	-	219	169
Area D	111	-	215	147	64	-	127	92	83	-	196	145	258	-	538	384

1/ Negative values indicate decrease in areas or water requirements.

would have a net increase in land under irrigation except Whidbey, Camano, and the San Juan Islands, projected to remain at current levels of development, and the Cedar and Green River Basins where a net reduction in irrigated land is projected due to urban and industrial growth onto the agricultural lands.

Reservoir Storage

Multiple and single-purpose reservoir storage included in the framework plan serves general water resources purposes as shown on table 106.

Table 106 - Planned Reservoir Storage, Area D

	Increments of Storage				
	1980	2000	2020	Total	Purpose 1/
	(1,000 ac-ft)				
Subregion 8					
Salmon Creek	150	0	0	150	FC, I, M, Rec
Cowlitz River	0	0	35	35	I, FC, Rec
Total	150	0	35	185	
Subregion 10N					
Chehalis River	60	0	0	60	FC, I, M, Rec
Willapa River	90	0	0	90	F, FC, I, M, Rec
Total	150	0	0	150	
Subregion 11					
Nooksack	63	21		84	F, FC, I, M, P, Rec
Skagit		134 2/		134	F, FC, P, Rec, WQ
Snohomish	434	15		449	F, FC, P, Rec
Cedar	50			50	FC, M
Puyallup		24		24	FC, I, M, Rec
Deschutes			15	15	FC, Rec
Total	547	194	15	756	
Area D	847	194	50	1,091	

1/ F-Fish; FC-Flood Control; I-Irrigation; M-Municipal-Industrial; P-Power; R-Recreation; WQ-Water Quality.
2/ Lower Sauk Project. Development of this increment depends on findings of the ongoing wild and scenic rivers study.

Some of these storage reservoirs are being studied by Federal agencies. The amount of storage in a river basin depends on the findings of these studies and the acceptance by the public.

Storage in the Cowlitz River Basin would provide the supply for a portion of the irrigation needs. A storage reservoir in the Salmon Creek area would provide 150,000 acre-feet of water for multiple-purpose use in the Vancouver area of southwest Washington. Alternatives include ground-water development, pumping from the Columbia River, and offstream storage.

On the Chehalis River, the multipurpose reservoir at Doty would provide for storage for irrigation, flood control, and municipal and industrial waters for the Centralia-Chehalis service area.

An alternative long-range plan includes the Alpha Dam and Reservoir to provide about 30-35,000 acre-feet of multiple-purpose storage in the upper Chehalis Basin. However, this alternative was not included in the plan as irrigation water is programmed to be supplied from ground-water sources in lieu of storage.

Along the coast the multiple-purpose Willapa project would provide storage for irrigation, fishery, and municipal and industrial uses. This reservoir would also provide flood control.

Multiple-purpose storage at various sites in the river basins of Subregion 11 is planned to provide the irrigation water supply, flood protection, reservoir recreation, and flow augmentation for esthetics, water quality, and fish and wildlife uses. Approximately 546,500 acre-feet of new storage would be developed for multiple-purposes at five sites and 155,000 acre-feet of flood control storage would be obtained by use of existing hydroelectric reservoirs at two locations. A total of 538,000 acre-feet of storage would be used for flood control. The major features also include 60,000 acre-feet of multiple-purpose storage at three sites, excluding the Lower Sauk Project and 194,000 acre-feet with this project. About 15,000 acre-feet of storage would be provided at a site on the Deschutes River.

Preservation and Enhancement of Natural Environment

Preservation of Rivers In the Skagit River Basin, the main river from Mt. Vernon to the mouth of Bacon Creek and the following sections of major tributaries--most of the Cascade River and its South Fork, most of the Suiattle River, and nearly all the Sauk River and its North Fork--have been selected by Congress for study to determine if they should be included in the national system of wild and scenic rivers. No other rivers in this area have Congressional designation for study; however, during the course of this study, many streams were found to have significant recreational and esthetic values. Table 107 lists systems of stream segments for study to determine whether they should be preserved as part of the national or a state system of wild, scenic, and recreation rivers.

Table 107 - Potential Recreation Streams, Area D

Description	Miles	Acres at 320/mile
Subregion 8		
Other Rivers Selected for Study		
Kalama River - from its source to its confluence with the Columbia River.	36	12,960
Washougal River - origin to mouth.	24	8,640
Lewis River - Merwin Dam to confluence with Columbia River.	19	6,840
East Fork of Lewis River - origin to confluence with Lewis River.	32	11,520
Cowlitz River - free-flowing segments from origin to mouth.	93	33,480
Cispus River - origin to confluence with Cowlitz River.	42	15,120
Toutle River - from the junction of the North and South Forks to its confluence with the Cowlitz River.	16	5,760
North Fork Toutle River - from origin at Spirit Lake to its confluence with the South Fork.	32	11,520
South Fork Toutle River - from origin to its confluence with the North Fork.	22	7,920
Lower Columbia River - Bonneville Dam to mouth.	146	23,360
Elochoman River - origin to confluence with the Columbia River.	16	5,760
Subregion 8	478 1/	142,880 1/
Subregion 10N		
Other Rivers Selected for Study		
Quillayute - from confluence of Bogachiel and Soleduck to mouth.	7	2,240
Soleduck - from Olympic National Park boundary to Quillayute.	50	16,000
Bogachiel - from Olympic National Park boundary to Quillayute.	22	7,040
Hoh - from Olympic National Park boundary to mouth.	30	9,600
Wynoochee - free-flowing segments from origin to mouth.	60	19,200
Naselle - origin to mouth.	28	8,960
Humptulips - origin to mouth.	28	8,960
West Fork - origin to East Fork.	28	8,960
East Fork - origin to West Fork.	17	5,440
Subregion 10N	270 1/	86,400 1/

1/ Impoundments not included.

Table 107 - Continued

Description	Miles	Acres at 320/mile
Subregion 11		
Rivers designated for study in the Wild and Scenic Rivers Act, P.L. 90-542 Sec. 5(a)		
Skagit River - Bacon Creek to Mount Vernon.	67	21,440
Cascade River - from confluence of North and South Forks to confluence with Skagit River.	19	6,080
South Fork - from Glacier Peak Wilderness to Cascade River.	2	640
Suiattle River - from the Glacier Peak Wilderness boundary at Mill Creek to the confluence with Sauk River.	29	9,280
Sauk River - from Elliott Creek to its confluence with the Skagit River.	43	13,760
North Fork, Sauk River - from Glacier Peak Wilderness boundary to its confluence with the South Fork of the Sauk.	6	1,920
Other Rivers Selected for Study		
Baker River - from origin to confluence with the Skagit River.	11	3,520
White Chuck River - from Glacier Peak Wilderness boundary to its confluence with the Sauk River.	16	5,120
Nisqually River - origin to Puget Sound.	69	22,080
Green River - origin to eastern city limits of Auburn.	54	17,280
Sammamish River - from Lake Sammamish to the eastern city limits of Bothel.	13	4,160
Skykomish River - origin to confluence with Sultan River.	15	4,800
North Fork - origin to confluence with South Fork.	24	7,680
South Fork - origin to confluence with North Fork.	20	6,400
Wallace River - origin to confluence with Skykomish River.	9	2,880
Beckler River - origin to confluence with Skykomish River.	12	3,840
Miller River - origin to confluence with Skykomish River.	10	3,200
Foss River - origin to confluence with Skykomish River.	9	2,880
Tyee River - origin to confluence with Skykomish River.	9	2,880
Pilchuck River - origin to confluence with Skykomish River.	36	11,520

Table 107 - Continued

Description	Miles	Acres at 320/mile
Stillaguamish River, North Fork - origin to confluence with the South Fork.	49	15,680
Deer Creek - origin to confluence with the North Fork, Stillaguamish.	19	6,080
Boulder River - origin to confluence with North Fork, Stillaguamish.	11	3,520
Squire Creek - origin to confluence with North Fork, Stillaguamish.	5	1,600
South Fork - origin to confluence with North Fork, Stillaguamish.	53	16,960
Jim Creek - origin to confluence with South Fork, Stillaguamish.	15	4,800
Canyon Creek and North and South Forks - origins to confluence with South Fork, Stillaguamish.	14	4,480
Nooksack River - origin to Puget Sound.	76	24,320
Middle Fork - origin to confluence with main stem.	17	5,440
South Fork - origin to confluence with main stem.	38	12,160
Snoqualmie River		
South Fork - origin to confluence with North Fork.	28	8,960
North Fork - origin to confluence with South Fork.	26	8,320
Tolt River - from the junction of its forks to the confluence with the Snoqualmie River.	9	2,880
Cedar River - from Chester Morse Lake to city of Renton.	34	10,880
Skokomish River - from junction of its forks to its mouth.	9	2,880
North Fork - Lower Lake Cushman Dam to confluence with the South Fork.	8	2,560
South Fork - origin to confluence with the North Fork.	26	8,320
Hamma Hamma River - origin to mouth.	18	5,760
Duckabush River - Olympic National Park boundary to mouth.	11	3,520
Dosewallips River - Olympic National Park boundary to mouth.	14	4,480
Big Quilcene River - origin to mouth.	17	5,440
Dungeness River - origin to mouth.	28	8,960
Morse Creek - Olympic National Park boundary to mouth.	8	2,560
Total Federal Study Rivers Section 5(a)	166	53,120
Total Other Rivers	840	268,800
Subregion 11	1,006	321,920
Area D	1,754 1/	551,200 1/

1/ Impoundments not included.

Minimum Flows for Environmental Values The natural environmental values of a stream depend both on the character of the shoreline and its flow characteristics. When the streamflows decrease below a reasonable level, the stream can be unattractive and lose much of its esthetic values. In addition to the environmental aspects, minimum flows of the stream are required for fisheries and for water quality. Section 90.22.010 of the Washington State Water Code (1969 1st ex. s. C 284S 3.) titled "Establishment of minimum water flows or levels--Authorized--Purposes" states that "The Department of water resources may establish minimum water flows or levels for streams, lakes or other public waters for the purposes of protecting fish, game, birds or other wildlife resources, or recreational or esthetic values of said public waters whenever it appears to be in the public interest to establish the same." The State of Washington is currently engaged in a program to establish these minimum streamflows.

The Clatskanie River and tributaries in Oregon were withdrawn by statutory decree of 1949 from further appropriation and from diversion and interruption for any purpose except for protecting fish life therein. This withdrawal does not affect any of the then existing rights to appropriate or use water, or any renewals or extensions thereof, or prevent appropriation and use of such water for domestic, stock, municipal, public park, or recreational purposes.

The Oregon Legislature also has declared it to be State policy that the maintenance of minimum perennial streamflows sufficient to support aquatic life and to minimize pollution shall be fostered and encouraged if existing rights and priorities will permit. The State Water Resources Board is empowered to establish minimum streamflows through adoption of water-use policy statements which are binding on all State agencies and public corporations of the State.

Landscape Management and Control Landscape management and control measures adjacent to the scenic roads, wild, scenic, and recreational rivers, around reservoirs, natural lakes, and as a buffer zone around recreational areas should be undertaken. The acreage required to satisfy this element has not been determined. Title in fee is not required for all lands, as the objective of this program is to provide a natural background setting for the enjoyment of all recreation visitors.

Wilderness and Primitive Areas Western Washington contains a number of Federal recreation areas with various restrictions placed on the recreation uses and activities. These include the long and well established Olympic and Mt. Rainier National Parks, portions of the Goat Rocks and Glacier Peak Wilderness areas, and parts of the recently established North Cascades National Park, Pasayton Wilderness, and Ross Lake National Recreation Area. Special studies to determine if these facilities are adequate to satisfy the needs for wilderness and primitive areas are included in the framework plan.

Historic and Unique Areas The framework plan for these areas should include provisions for their preservation and for necessary facilities to accommodate visitors. This includes means for access such as trails, roads, camp sites, and parking facilities. To meet these needs an interdisciplinary study is required to identify additional scenic, historic, and unique areas and to prepare a plan for their preservation and development for historical and recreational values. All existing National Monuments, Historical Sites, areas declared eligible as Registered Landmarks, and similar state areas are to be preserved.

Urban Environmental Protection and Development Methods for preserving and enhancing qualitative aspects of the Puget Sound Area would be studied, and a plan developed. The emphasis would be on methods to provide for livability in harmony with expansion of the economy and population.

Urban Waterfronts The land area peripheral to surface waters in urban areas has been intensely developed, particularly port areas of cities such as Tacoma and Seattle, and used without benefit of any formal planning. This often has resulted in development of the land resource and the adjacent water resource in such a manner that the areas involved are not viable in an economic context, undesirable in an environmental context, and unsightly in an esthetic context. The framework plan includes studies to identify the severity of this problem and to develop plans which would guide the redevelopment and refurbishing of the affected areas, and future development of these areas. The goal would be the creation of urban waterfronts that are economically viable, environmentally acceptable, and esthetically desirable.

Other Measures The high country in the Cascades has a fragile ecological balance; and, while the apparent need is to increase the recreational capacity through a strong development program, care must be taken lest the resource itself be destroyed

by overuse. A study is needed to find answers to the question of the proper level of human use in the high country, prior to initiation of development programs. Both winter and summer sport activities are involved. The study should be completed as early as possible to prevent any irreversible damage by the ever-increasing number of recreationists.

Many rivers tributary to salt water, including the lower Columbia, have abandoned piling which obstructs the recreational use of the river and impairs the scenic values. The removal of all piling, except those used by wildlife, is recommended as soon as they have served their purpose.

One of the measures which should not be overlooked in this initial framework planning for the use of the water and related land is a land-use plan. Although such a plan is beyond the scope and authority of this study, it is recommended as an additional study because the future competition for land will be particularly keen in this area.

Additional elements and measures of the plan contributory to the preservation and enhancement of the natural environment are discussed under water quality, fish and wildlife, recreation, and coastal zone and estuaries.

Fish and Wildlife

Because of its location below major hydroelectric facilities in the Columbia River drainage, and its proximity to the Pacific Ocean, Subregion 8, Lower Columbia River, has significant potential for production of anadromous fish. Several of its tributary watersheds have suitable water supplies for hatcheries and fish rearing ponds. If this habitat is protected and restored, the subregion has the potential for satisfying many of the regional needs for anadromous fish while also meeting local needs for resident fish.

Subregion 10N, Washington Coast, contains numerous spawning and rearing areas for anadromous fish, as well as several estuarine areas which are important for shellfish production. In addition, most of Washington's charter-boat fishing fleet use harbors in the subregion. Nonresident use of charter-boat facilities is a growing national demand that can be satisfied in relatively few locations. This subregion has the potential to satisfy many regional and national needs while also meeting local needs.

The varied marine and fresh water environments in Subregion 11, Puget Sound, support a wide and abundant variety of fish and shellfish and offer a wide range of commercial and recreational

opportunities. The fish production capabilities of these waters are considered good to excellent.

The area contains a wide variety of wildlife which can be subdivided into classifications such as big game, upland game, fur animals, waterfowl, and other wildlife. Big game species found in the area are black-tailed deer; Roosevelt and Rocky Mountain Elk, black bear, mountain goat, and mountain lion. In addition the area has a small remnant of a much larger herd of Columbia white-tailed deer. The upland game species include ring-necked pheasant; valley and mountain quail; blue, ruffed, and spruce grouse; mourning dove; band-tailed pigeon; cottontail; snow-shoe rabbit; and gray squirrel. More than 20 species of ducks, black brant, snow geese, and several races of Canada geese are common to the area. In addition to the above mentioned species, there are numerous species of other wildlife which are scattered throughout the area, some of which are important because they conflict with man's interest, are sought by sportsmen, or have a commercial value.

The framework plan contains programs to maintain or enhance the fish and wildlife base; and, insofar as possible, to meet the projected fishing and hunting user-day needs shown in table 95. Major elements of the plan for fish and wildlife are shown in table 96, Framework Plan Composition. These measures do not include special actions that will be needed to offset or minimize the detrimental impact of stream channelization, urban sprawl, etc., on fish and wildlife habitat.

Fish The framework plan includes preservation and protection on an estimated 2,660 miles of streams in the area, more than one-half in Subregion 11. An impact study should be made of any development affecting streams, and any permanent alteration detrimental to fish habitat should be avoided, unless clearly needed to meet other water needs.

Habitat improvement programs will be applied on about 2,800 miles of streams, including such measures as stream channel preparation, spawning bed improvement, development of artificial spawning channels, rearing ponds, and nongame fish control. Habitat improvement practices will also cover 81,000 acres of lakes in the area. Habitat improvements included in the first time period include 490 miles of streams and 34,000 acres of lakes. Adequate streamflow during the summer months, when water supplies are generally at a minimum, is vital for fish habitat protection and improvement.

Contrary to common views, many streams in this area of higher rainfall still suffer from low summer flows, especially in the coastal subregion where watersheds are small and snowmelt runs

off early. There are also hundreds of stream obstructions that should be removed to increase the stream miles available for anadromous fish. The streams and type of obstruction are listed in Appendix XIV, Fish and Wildlife. Also listed are many of the streams subject to inadequate flows.

The harvest of both resident and anadromous fish can be increased and much of the projected needs satisfied by improving access to streams, lakes, and salt water areas. The program to improve fishing access includes over 3,000 miles of stream, about 250 lakes, and over 400 salt water access sites. Some of the lakes and streams are presently accessible but access areas need to be modified or enlarged to accommodate future needs. Warm water fish populations have a capacity for significant increased used. Additional access for resident trout angling would also benefit the warm water fishery where both groups are found. Future needs for warm water fish will be satisfied through 2020 provided the present level of management continues.

Similarly, the highly successful hatchery program now being employed will be expanded. Increased production in existing hatcheries can be accomplished through water reuse, controlled environment, improved feeds, disease abatement, and many other techniques. A total of 79 new or expanded hatcheries is necessary in the area to meet future needs. Existing ponds or small impoundments suitable for rearing anadromous fish need to be identified and reserved for this purpose. The framework plan includes an additional 1,700 acres of small impoundments for rearing purposes. The plan also provides for preserving and managing beaches, headlands, and estuaries for the benefit of the shellfish and other marine life associated with the coastal zone. The Willapa Bay and Grays Harbor estuaries in Subregion 10N and the entire Puget Sound estuary are some of the Nation's prime areas for production of oysters, clams, and other seafoods. In fact, Willapa Bay is the single most productive shellfish area in the Nation. The current residential-recreation development and its accompanying septic tank-drain field discharges on the Long Beach Peninsula are conflicting with the shellfish industry which is a primary economic livelihood for the area.

<u>Wildlife</u> Preservation of existing wildlife habitat is essential. To satisfy demand, maximum potential of key wildlife areas must be realized and better use and enhancement of the resources of all areas required. Preservation of marsh and key estuarine areas vital to waterfowl, fur animals, shore birds, and shellfish is essential during future industrial and urban development of salt water bays.

There are numerous opportunities to preserve wildlife habitat. Green belts and flood plain zoning, as well as zoning in other areas, can help preserve wildlife habitat by preventing or controlling the intrusion of industrial or urban development into vital areas. Appendix XIV, Fish and Wildlife, contains many details on areas which should be preserved.

The plan provides for wildlife habitat improvement on an estimated 544,000 acres between 1970 and 2020 (Subregion 8--127,000 acres; Subregion 10N--138,000 acres; and Subregion 11--279,000 acres). Improvement practices include development of shallow impoundments; seeding and planting of wildlife food crops; forage release and burning; establishment of permanent openings; key area fencing of more than 800 miles; marsh developments; and nesting facilities. Habitat improvement would be accomplished in part by these specific wildlife practices and in part from multiple-use management practices that give priority consideration to wildlife habitat in critical winter range areas and important upland game and waterfowl areas. Measures to increase hunting would also include augmentation of bird supply by game farm rearing of some 155,000 game birds.

Land acquisition is planned either by fee purchase of easement rights to assure control of wildlife habitat on about 310,000 acres. An area of suitable habitat would be designated as a refuge for white-tailed deer. These areas would be managed by fish and wildlife agencies primarily for protection and enhancement of wildlife resources. A number of the above habitat improvement practices would be effected on these lands.

The area contains considerable land that is closed or subject to closure to hunters. In addition, a substantial amount of huntable land receives less than maximum use because of remoteness or lack of facilities such as roads, camping areas, etc. Although several thousand acres probably fall in this category, studies are needed to determine specific access requirements and hunting potential. Special studies are also needed to determine conflicts with fish and wildlife resources and other uses if hunting effort is intensified, and quality versus quantity of hunting must also be appraised.

These and other wildlife habitat preservation, enhancement, and harvest requirements would be better identified following development of big game range analysis and upland game habitat management plans. These, scheduled in the 1970 to 1980 time period, are additional to ongoing priority game and habitat surveys conducted by resource management agencies.

Land and Water Requirements Table 108 shows some of the significant water and land projections associated with fish and wildlife plan elements.

Table 108 - Planned Fish & Wildlife Land and Water Requirements, Area D

Item	Units	1970	1980	2000	2020
Fish hatchery water withdrawals	1,000 ac-ft	994	1,229	1,586	2,319
Water withdrawal for wildlife areas 1/	1,000 ac-ft	11	22	25	30
Fish & wildlife water areas 2/	1,000 ac	326	327	327	330
Wildlife land use 3/	1,000 ac	13,950	13,730	13,504	13,256
Controlled wildlife land use 4/	1,000 ac	30	167	248	340

1/ Includes water developments primarily for waterfowl enhancement.
2/ Includes small critical fishing waters (less than 500 acres each) and high quality waterfowl habitat.
3/ Most land area is used in varying degrees by wildlife.
4/ Lands operated or owned and managed by fish and wildlife agencies specifically for wildlife control and enhancement.

Outdoor Recreation

Water related recreation use in this area is expected to increase from 29.1 million recreation days in 1970, to 207.1 million by 2020. The plan includes appropriate facility development and necessary land and water surface areas to accommodate this additional 178 million recreation days. Projected recreation day use and required land and water areas are given in table 96, Framework Plan Composition.

Boating activity, including sport fishing and water skiing, will increase substantially by 2020 as indicated by the projection of pleasure boats given in table 109. These activities will utilize 894,200 acres more water surface by 2020 than the 186,500 acres used in 1970. Water surface, including fresh water and protected salt water areas of these subregions, far exceeds this demand. Increased demand will occur near the urban and heavier population areas creating local fresh surface-water deficiencies, and recreationists are expected to utilize adjacent salt water areas to a greater extent.

An additional 65,700 acres of land would be developed for water related recreation activities such as camping, picnicking, and provision for water access, compared to 6,700 acres in 1970. This development would also include more rest facilities, boat launching areas and ramps, swimming beaches, and other related activities. About 13,000 acres would be in private development, 4,000 acres on Federal lands, 24,000 acres on county or municipal lands, and 25,000 on State lands. To meet these requirements,

county and municipal authorities must acquire an estimated 20,300 acres while the State governments need to acquire some 20,000 acres.

Table 109 - Planned Elements, Recreation Boating, Area D

Sub-region	Pleasure Craft 1970	Pleasure Craft 1970-2020	Pleasure Craft Total	Launching Lanes 1970	Launching Lanes 1970-2020	Launching Lanes Total	Land Requirements 1970	Land Requirements 1970-2020	Land Requirements Total
		(1,000)			(each)			(acres)	
8	16	90	106	110	633	743	225	1,315	1,540
10N	12	51	63	90	350	440	168	1,380	1,548
11	186	854	1,040	325	1,025	1,350	2,740	14,060	16,800
Area D	214	995	1,209	525	2,008	2,533	3,133	16,755	19,888

Source: Appendix XIII, Recreation.

Significant elements of the plan, relating both to water related recreation and to environmental protection, are the required studies of free-flowing rivers, scenic roads, and roadless areas to identify those which should be formally recommended for preservation and protection. Table 107, in the section on Preservation and Enhancement of the Natural Environment, lists about 1,754 miles of streams or rivers which should be studied early in the planning period for possible designation as wild, scenic, or recreation rivers in the free-flowing rivers system.

Some 700 miles of highways and roads, having particularly scenic and esthetic attractions along streams, lakes, and rivers, with surrounding mountains and forests, have been identified for the scenic road system in this area. An additional 1,400 miles of highways should be studied in the first time period to determine which should be designated and managed as scenic roads. Along with the present 609,000 acres in primitive, wilderness, or roadless areas now established in the area, another 614,000 acres have been identified for early study as potential additions.

Related Land Programs

The programs include a broad range of watershed measures and practices designed to reduce erosion and sedimentation, conserve and improve water quality, and alleviate flood damage and wetness problems through a combination of management practices, land treatment, and structural measures. Many different practices will be required on some of the same land; some will be recurrent in each planning period; and a number of measures will serve both improved watershed needs and production or other management objectives.

Erosion and sediment control practices are required on 67,000 acres of rangeland, 814,000 acres of forest land, 61,000 acres

of cropland, and 3,000 acres of beach land. Cropland practices include grade stabilization structures, diversions, ditch bank seeding, crop residue use, and shifts to pasture and hay use in areas of higher erosion potential. In forest areas, trees and grass will be reestablished on eroding or deteriorating lands with particular attention following timber harvest, and existing or abandoned forest roads and trails will be estabilized. Rangeland practices include grass seeding to establish protective cover along with brush and weed control, contouring, and road stabilization, including treatment by vegetative practices and construction of drift fences. Supplementing these measures, more than 3,000 detention structures and small check dams will be constructed in cropland and rangeland areas.

Water needs for irrigation may partially be met through more careful management of irrigation systems. Some systems, now individually operated, should be combined for more efficiency. Irrigation system improvement will include ditchlining and pipelines to reduce transmission loss and additional and enlarged storage and control facilities. Along with major water storage facilities, an estimated 2,995 ponds and small reservoirs with a capacity of about 31,000 acre-feet should be developed to serve increased irrigation needs and to store water for stock and wildlife use. Drainage will be accelerated to eliminate wetness problems on 61,000 acres by 1980, and an additional 92,000 acres by 2000 and 77,000 acres by 2020.

A number of tributary stream control measures and adjacent land protection practices will help attain watershed objectives in erosion and sediment control, flooding, and water conservation. About 1,519 miles of bank stabilization work is planned between 1970 and 2020 along streams and reservoirs. Some 695 miles of local dikes and levees will be constructed in croplands. Intermittent channel improvement work will be accomplished along some 3,365 miles of streams and rivers. Most of this latter effort will be along tributaries in forest areas and includes a variety of practices such as removal of obstructions and debris, measures for reduction of pollution and improved water quality, and clearing the way for fish migrations. The land treatment and management practices that are planned have been placed in similar groups and appear in table 96, Framework Plan Composition.

Nature and Extent of Further Studies

River Basin Studies In several basins or reaches in the Lower Columbia-Western Washington area, problems are complex and available data were not sufficient to select the best plan from an array of possible alternatives. Accordingly, additional

interdisciplinary studies are necessary to further identify alternative methods, programs, projects, and uses of water and related land resources, to evaluate the impact of alternative land uses and projects on the environment, and to select the proper alternatives and the entity to carry out each feature of the resulting plan. Studies relevant to future more detailed planning which are now underway by State and Federal agencies in this area are listed in table 110.

These studies would cover most of the river basins or subareas that contain unresolved problems. Washington has participated in two large studies that cover a major portion of western Washington. These are the Type 2 Puget Sound & Adjacent Waters, completed in 1971, and the Type IV-Southwest Washington river basin studies scheduled for completion in 1973. In addition, Washington and Oregon, with some Federal agencies, are making a cooperative study of the lower Columbia River to form a water and land use plan that considers industrial, commercial, and residential waterfront areas along with recreation, wildlife, and agricultural land use. The Cedar and Green River Basin studies in which the State is participating will also clarify many of the unresolved water quality and supply problems now facing the residents of those drainages.

In addition to these studies, individual agency studies will answer many of the unresolved problems. Some completed studies can also be utilized with minor updating. The primary questions to be resolved concern multiple-purpose storage reservoirs in the Chehalis Basin; storage for water supply and irrigation near the Long Beach Peninsula; development of comprehensive land use plan for the lower Columbia River; the proper water and land use of the estuaries and seacoast considering ecological, economic, and environmental aspects; finalization of plans for the Puget Sound programs; siting of thermal powerplants; and establishment of minimum flows for water quality, esthetics, fish, and other purposes.

Frequently cooperative efforts by a group of land managers and owners are necessary to effectively install a combination of practices, land treatment measures, and water conservation and control structures necessary to meet the more intense multiple-use requirements of lands and resources. Small watershed areas have been tentatively identified where the complexity of watershed problems and the multiple ownership of lands require such a coordinated effort. Additional economic evaluation studies are required to select the watersheds economically feasible to develop. The number of watersheds selected for study is shown on table 96 under the study category.

Table 110 - Studies Underway, Area D

Area	Purpose	Agency	Completion
SW Washington	Type IV	Wash. USDA	1973
Chinook-Wallicut	Multiple-Purpose	SCS-FS	
Skagit River	Wild River	FS	1974
Mt. Baker National Forest	Water Use Inventory	FS	1972
Snoqualmie National Forest	Water Use Inventory	FS	1972
Olympic National Forest	Water Use Inventory	FS	1972
Seattle Harbor-Duwamish Waterway	Navigation	CE	1974
Puyallup River Basin	Flood Control	CE	1975
Chehalis River Basin	Flood Control & Flood Plain Management	CE	1974
Nooksack River	Multiple-Purpose	CE	1972
Snohomish River	Multiple-Purpose	CE	1975
Grays Harbor	Navigation	CE	1975
Elliott Bay	Navigation	CE	1974
Willapa Harbor	Navigation, Beach Erosion	CE	1972
Lower Columbia River	Multiple-Purpose	CE	1977
Duwamish River Estuary	Water Quality	GS	Continuing
Skookumchuck River	Multiple-Purpose	GS	Continuing
Port Susan	Fish & Wildlife	BSF&W	1971
Nisqually	Fish & Wildlife	BSF&W	1971
Cedar & Green River Basins	Water Quality	EPA, State, CE, Local Government	1974
Columbia River & Tributaries	Multiple-Purpose	CE	1977
Upper Baker River	Flood Control	CE	1974
Stillaguamish River	Flood Control	CE	1974
Cedar River	Multiple-Purpose	CE	1974
Tacoma Harbor	Navigation	CE	1974

The Skagit Wild River study should answer many of today's questions regarding the recreation and preservation aspects as opposed to the developmental approach which would include multiple-purpose storage.

In the Nisqually River Delta, opportunities exist for development of a wildlife refuge and outdoor recreation area, or for terminal and water transport oriented industrial development. Further studies and public expression are required before a final determination can be made as to the best use or uses of this delta area.

The entire coastal zone, including the Puget Sound, needs to be carefully examined from the standpoint of beach erosion; preservation of estuarine areas for fish, shellfish, and wildlife; thermal powerplant siting; port facilities; harbors of refuge for small boats; and adjacent land uses such as recreation facilities, commercial developments, and preservation of unique and scenic sites. The study area should include all beaches, estuaries and headlands fronting on the Pacific Ocean, plus the San Juan Islands, Whidbey-Camano and other islands, Hood Canal, and other straits and inlets of Puget Sound.

Table 111 - Special Studies, Area D

Type	Scope and Extent
Minimum Flow Requirements	Study of area streams to establish minimum flows for esthetics, water quality, and fisheries. Include cross sections of streams where required.
Stream Preservation	Study of 1,754 miles on 63 streams to determine whether they should be included in state or national system of wild, scenic, and recreation rivers.
Scenic, Historical, or Unique Areas	Identify scenic, historic, and unique areas, and develop plan for preservation and public use.
Habitat Improvement for Fish and Wildlife	Identify areas where habitat can be improved effectively and develop plan for improvement.
High Alpine Areas of Cascade Range	Determine level of human use commensurate with fragile ecological balance in high alpine areas of Cascade Range.
Lower Columbia River Shorelands	A detailed study of instream use and its effect on shoreland use and the development of a plan to guide future shoreland use, and the consolidation of all recreation and scenic activities into a recreation and scenic parkway.
Scenic Roads Along Streams	A study of scenic roads along streams and development of scenic road plan with proposals for improving scenic opportunities.
Urban Environmental Protection and Development	Study methods for preservation and enhancement of qualitative aspects of the Puget Sound Area and develop a plan which provides for livability in harmony with expansion of population and the economy.

Table 111 - Continued

Type	Scope and Extent
Urban Waterfronts	Study urban waterfronts to identify developments which are not viable in an economic context and undesirable or or unsightly from an environmental or esthetic context, and develop a plan for redevelopment or refurbishing and guiding future use. The goal would be the creation of urban waterfronts which are economically viable, environmentally acceptable, and esthetically desirable.
Power Plant Siting	Identify areas most suitable for installation of pumped storage and thermal-electric power plants considering aspects of economics, environment, air and water pollution and safety.
Land Use Planning	To develop tentative master plans for critical land areas considering environment, recreation, economic, wildlife, and other uses.
Primitive Areas	Study approximately 614,000 acres of roadless area for possible inclusion in a Federal or State wilderness system.
Navigation, Beach Erosion	Detailed study on improvements of Willapa Bay for environment, navigation, and beach erosion at Cape Shoalwater to include hydraulic model.
Regional Harbor Study	Study of regional navigation requirements in view of changing shipping technology.

Some generalized studies that should be incorporated in ongoing study programs or undertaken separately are shown in table 111.

Evaluations

General

The framework plans and programs for the Lower Columbia-Western Washington Area were formulated to satisfy the projected functional needs that have been identified with full recognition given to environmental aspects. Storage facilities, flood control works, irrigation, and other structural elements of the plan would be located and designed to preserve as much as possible of the prime recreation, wildlife, and esthetic areas. Key environmental areas are not only preserved but enhanced under the plan. Specific elements of the plan are briefly stated in the following:

(1) Environmental and esthetic values would be restored and enhanced by:

Establishing realistic minimum flows on all streams to improve esthetic values, fish and wildlife habitat, and to aid in pollution control. Provisions would be made to augment low streamflows when so indicated by the above studies.

Waste treatment to remove 85 percent of organic wastes from municipal and industrial effluents by 1980, and 90 percent by 2000 in all areas except where not required in Subregion 11.

Study of 1,754 miles of 63 streams to determine those that should be included in state or national system of recreation rivers and subsequent designation of those found to qualify.

Landscape management and control including removal of old piling from rivers and estuaries.

Developing a coordinated water and land-use plan along the lower Columbia River and establishing the proper level of human use of the fragile environment of the high Cascade Range.

Requiring cooling ponds, towers, or mechanical draft cooling to eliminate any discharge of warm water into fresh water streams or lakes by thermal electric powerplants.

Expansion of existing wilderness and primitive areas and designation of new ones.

(2) Recreation needs would be met by:

Development to provide for an increase of 16.9 million recreation days by 1980, 73.1 million days by 2000, and 178 million days by 2020. Additional development would be required on 65.7 acres, and 40.3 acres of land would be acquired for urban recreation.

Studies to consolidate recreation, scenic, and fish and wildlife programs.

(3) Fish and wildlife needs would be met by:

Preservation and protection of fish habitat on 2,660 miles of stream systems. The improvement of habitat on over 2,800 miles of streams and 81,000 acres of lakes. Augmentation of the supply of fish by 79 hatcheries and almost 1,700 acres of rearing ponds. Provide access to 3,000 miles of streams and 656 access sites to lakes and salt water areas.

Acquisition of wildlife habitat on 310,000 acres and improvement on 544,000 acres. Over 155,000 game birds would be produced annually on game farms, and hunting access would be improved on 11.3 million acres.

(4) Food and fiber needs would be met by:

About 538,000 acre-feet of water, 357,000 acre-feet from surface, and 181,000 acre-feet from ground water for 258,000 acres of new irrigation.

(5) Need for streamflow would be met by:

One million ninety-three thousand acre-feet of multiple-purpose storage to augment flows for irrigation as well as providing flood control, recreation, and fisheries. The final location and scoping of storage are dependent on the plan selected by detailed interdisciplinary studies.

(6) Transportation needs would be met by:

Deepening the lower Columbia River channel and other deep-draft channels and construction of 14 miles of breakwater by 2020. Over half the channel work would be in Subregion 8, and all the breakwaters in Subregion 10N.

(7) Watershed management and treatment by:

Programs and practices to be accomplished on 216 watersheds; erosion and sediment control on 946,000 acres; water conservation on 268,000 acres; protection and management on 12 million acres; water yield improvement on 113,000 acres; drainage on 230,000 acres; bank stabilization on 1,519 miles; 695 miles of dikes and levees; channel improvements on 3,365 miles, 3,067 control structures; 2,995 small ponds and reservoirs.

(8) Electric power would be provided by:

Existing sources, new sources outside the area included in the regional plan, and installation of additional capacity of 617 MW, mostly at existing hydroelectric plants and 55,580 MW of thermal power by 2020, using both evaporative and once-through cooling. Pumped storage may also be utilized in the later time periods.

(9) Flood control would be provided by:

Flood plain management including flood plain regulation, flood information reports, and flood proofing at 18 initial locations. Levees and channelization totaling 573 miles. No single-purpose flood control storage was included; however, some 949,300 acre-feet of joint use storage would be utilized for flood control. The only unmet need was flood control where residual damages on major streams of nearly $5.5 million would remain at 2020

(10) Municipal, industrial, and rural domestic water would be supplied by:

Expansion of existing sources of supply and extension of distribution systems considered adequate. About 3,306,000 acre-feet of water would be required to supply the 2020 needs. The present requirements are about 1.6 million acre-feet.

(11) Further studies would be undertaken on:

The Chehalis River and the Salmon Creek-Lewis River areas to determine if future water supplies should be developed from storage or ground water. Special studies are necessary in several locations, particularly the lower Columbia River shoreline; the Willapa Bay, Grays Harbor, and Puget Sound estuaries; and the Cedar (Lake Washington)-Green drainages.

In summary, the plan generally meets nearly all needs, but several aspects require more detailed interdisciplinary studies to determine the best use for some water and land areas. For instance, the lower reach of the Columbia River proposed for channel improvement in the interest of navigation must be studied by Federal agencies and Oregon and Washington to develop a master plan for disposal of dredge spoil that is compatible with use of the shore area for recreation, wildlife, and commercial uses. The plan recommends these types of special studies to resolve particular problems.

Water Resource Situation

Surface Water The total water supply is ample to meet both the projected consumptive and instream uses. However, because of seasonal differences in precipitation and streamflow, storage is required to provide flows for both types of use.

Between 1970 and 2020, the increase in withdrawals will be 5.384 million acre-feet and depletions will increase 1.873 million acre-feet. Table 112 shows a breakdown of these figures by time and use.

The mean annual runoff originating in the Lower Columbia-Western Washington Area is approximately 81 million acre-feet. An additional 707,000 acre-feet originate in Canada and flow through the area, principally via the Skagit River (figure 26). This does not include the inflow of the Columbia and Willamette Rivers to Subregion 8 because this flow is available to a very limited portion of the area. In 1970, the surface-water depletions amounted to 558,000 acre-feet, see table 112. Although depletions total less than 1 percent of the total runoff, some streams are seriously depleted during low-flow seasons. Under projected 2020 conditions and with implementation of the framework plan, total depletions from surface water would be increased to 2.32 million acre-feet, approximately 3 percent of the total runoff. Because of unequal distribution of runoff, both by time and area, some storage will be necessary to make this amount of water available as needed.

The largest withdrawals of surface water are for industrial purposes followed by diversions for fish and wildlife propagation and municipal supplies. Two to fourfold increases are projected in diversions for these purposes and for irrigation, and diversions for thermal-electric power are projected to increase to more than 30 times their present volume. The instream uses of water vary by subregion and distance from salt water. Commercial navigation is a large user of the lower Columbia River, Puget Sound, Willapa

Bay, Grays Harbor, and the lower reaches of rivers tributary to the Columbia River and salt water areas. Upstream the primary use is fish, recreation, waterfowl, and, in a few rivers, for generation of hydroelectric power.

There are few large storage reservoirs in this area and most are primarily operated for power generation but they also provide incidental benefits for flood control, recreation, fish, and waterfowl. Only two have any exclusive flood control space, several have municipal use, but none serves irrigation. The total installed hydroelectric power capacity in 1970 was 2,177 MW and, by 2020, the planned additions would raise this total to 2,800 MW.

Ground Water The areawide ground-water supply is adequate to meet all projected needs and the annual recharge is more than adequate to maintain the supply. The estimated annual recharge exceeds 23 million acre-feet, and the estimated annual increase to 2020 in ground-water depletions is only 230,000 acre-feet. The major ground-water recharge is in Subregion 11, 11 million acre-feet, followed by Subregions 8 and 10N, with 6.3 and 6 million acre-feet respectively.

In spite of the apparent large ground-water supply, there are localized areas that are becoming concerned over future supplies and other areas where ground-water withdrawals could affect surface-water availability. The Vancouver-Camas area is one example of an area that relies heavily on ground water for municipal and industrial uses. Adequate quantities are available in that area from aquifers fed by the Columbia River but problems of suitability for certain specialized uses may arise. Studies should be made to determine the quantity and quality of ground water in critical areas.

Contrary to anticipated surface-water uses, irrigation accounts for the greatest projected ground-water use. About 59 percent of the withdrawals and 75 percent of the depletions result from projected irrigation use.

Depletions The largest consumptive use of water in the area is for irrigation and industry, followed by fish and wildlife propagation and municipal supplies. Consumption for these uses is projected to increase two to threefold by 2020, but consumptive use for thermal-electric power is projected to increase more than thirtyfold. By 2020, consumptive use for thermal-electric power is expected to exceed all other categories.

Excessive depletions are not expected to cause serious problems except in the Lake Washington drainage where salt water

Table 112 - Summary of Water Withdrawals and Depletions, Area D

Use	Ground 1970	Ground 1980	Ground 2000	Ground 2020	Surface 1970	Surface 1980	Surface 2000	Surface 2020	Total 1970	Total 1980	Total 2000	Total 2020
						(1,000 ac-ft)						
						Withdrawals						
Municipal	75	114	174	278	317	488	758	1,252	392	602	932	1,530
Industrial	152	196	289	357	1,041	1,398	2,179	2,976	1,193	1,594	2,468	3,333
Rural-Domestic	25	28	39	51	1	2	2	3	26	30	41	54
Irrigation	116	172	232	297	197	356	423	554	313	528	655	851
Thermal Power	-	-	-	-	24	70	284	804	24	70	284	804
Fish & Wildlife	3	33	58	71	1,002	1,218	1,553	2,278	1,005	1,251	1,611	2,349
Other	0	0	0	0	0	0	0	0	0	0	0	0
Total	371	543	792	1,054	2,582	3,532	5,199	7,867	2,953	4,075	5,991	8,921
						Depletions						
Municipal	14	23	35	56	64	98	151	250	78	121	186	306
Industrial	30	40	59	70	209	278	435	595	239	318	494	665
Rural-Domestic	5	6	8	10	0	0	0	1	5	6	8	11
Irrigation	86	132	176	221	156	257	305	405	242	389	481	626
Thermal Power	-	-	-	-	24	70	284	804	24	70	284	804
Fish & Wildlife	2	4	8	10	105	134	168	242	107	138	176	252
Other	0	0	0	0	0	0	0	0	0	0	0	0
Total	137	205	286	367	558	837	1,343	2,297	695	1,042	1,629	2,664

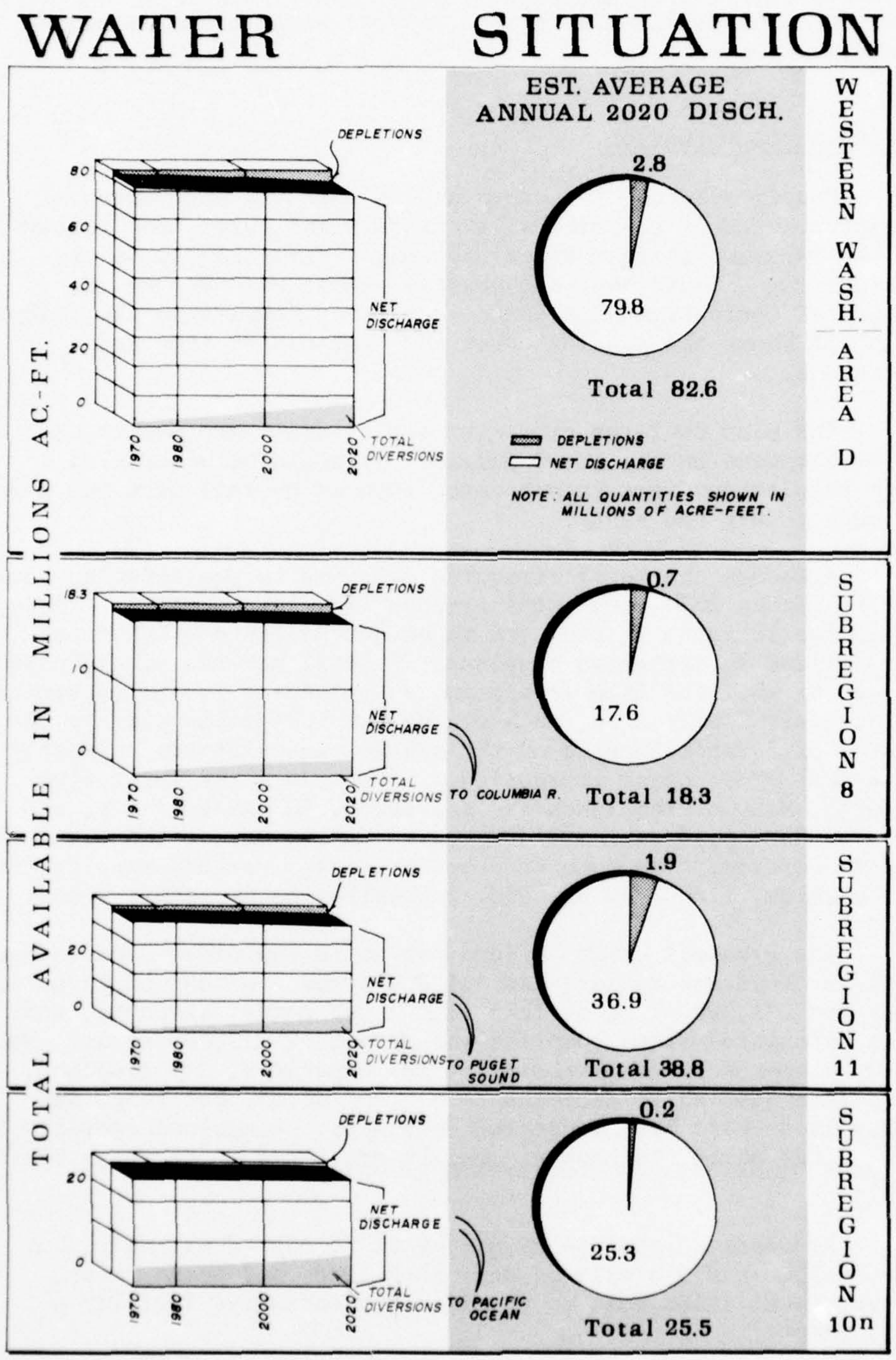


FIGURE 26. Projected Water Supplies, Withdrawals, and Depletions, Area D

intrusion into the lake and other water quality problems may result from use of Cedar River water for city of Seattle municipal and industrial supplies.

Land Resource Situation

Proper planning to retain and enhance the environmental characteristics of the area will maintain the basic land resource but the increase in recreation user-days, particularly in the populous Puget Sound and some coastal areas, will reduce the quality of recreation experience to a lower level than now enjoyed. Table 113 shows the planned cover and land use by time and subregions.

The plan contains provision for establishment of regulations for development on all flood plains. It would be beneficial if these regulations were incorporated into an overall land use plan for each county and state.

Although the total irrigated cropland is projected to more than triple by 2020, the total acreage will not be large. Nearly all of the increase is expected to be accomplished by shifting from dryland to irrigated cropland. A small portion is expected to come by shifting from forest and rangeland to irrigated cropland. In the Clark County area, much of the new irrigation will be on Class 1 or 2 lands located on the benches and plateaus currently dryfarmed. Most other irrigation will be along the lower river valleys. Many of the lands are scattered, in small tracts, and would be developed on individual-basin basis, rather than project-type facilities. The type of crops is highly varied, ranging from hay, berries, flower bulbs, and cranberries to Christmas trees.

The greatest shift in land use is in the other land category which is projected to increase 591,000 acres. Urban and industrial areas are 278,000 acres of this amount and roads, airports, and other associated items comprise the remaining 313,000 acres. Much of this area will be developed at the expense of dry cropland, which is projected to decrease by 610,000 acres, but range and forest lands also have projected decreases. Rangeland decrease is only 30,000 acres, but forest land is projected to decrease 321,000 acres.

Recreation land use is projected to expand markedly, but much of the land use will be on forest lands and beach areas. However, some lands must be acquired for intensive facility development.

New wild, recreation, and scenic rivers are potentials that are identified but the plan calls for studies to select those most

appropriate to satisfy the local and state interest as well as the national interest. Over 600,000 acres of potential wilderness areas have been identified and future demand may require such classification.

The Lower Columbia-Western Washington area contains significant big game, waterfowl, and upland bird habitat. The total natural habitat area is projected to decrease as a result of recreational expansion and general development of roadways and towns. However, the big game animals and bird populations are expected to increase per unit of area due to intensive management measures. In areas where big game winter habitat is becoming scarce or critical, the plan provides for curtailing competing land use.

It is very essential that all resource uses for every parcel of land in this area be considered in future planning and development. To insure that competing land resource uses are adequately provided for, a comprehensive land-use plan which establishes State goals and priorities of use in each river basin should be developed by each state.

Table 113 - Summary of Planned Cover and Land Use, Area D

	Planned Amount															
	Subregion 8				Subregion 10N				Subregion 11[1]				Area D Total			
	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020
								(1,000 ac)								
Area Cover & Land Use																
Rangeland	68	65	60	60	55	53	49	46	105	105	100	92	228	223	209	198
Forest Land	2,665	2,652	2,649	2,618	3,674	3,665	3,653	3,640	6,429	6,419	6,336	6,189	12,768	12,736	12,638	12,447
Commercial	(2,474)	(2,461)	(2,458)	(2,427	(3,209)	(3,200)	(3,188)	(3,176)	(5,004)	(4,994)	(4,911)	(4,764)	(10,687)	(10,655)	10,557)	(10,367)
Noncommercial	(191)	(191)	(191)	(191)	(465)	(465)	(465)	(464)	(1,425)	(1,425)	(1,425)	(1,425)	(2,081)	(2,081)	(2,081)	(2,080)
Cropland	201	176	145	134	162	125	109	92	591	470	403	385	954	771	657	611
Irrigated	(17)	(54)	(66)	(98)	(13)	(53)	(59)	(75)	(92)	(134)	(180)	(216)	(122)	(241)	(305)	(389)
Nonirrigated	(184)	(122)	(79)	(36)	(149)	(72)	(50)	(17)	(499)	(336)	(223)	(169)	(832)	(530)	(352)	(222)
Other Land	259	282	312	344	179	216	242	270	1,322	1,433	1,576	1,737	1,760	1,931	2,130	2,351
Urban & Industrial	(51)	(52)	(54)	(58)	(45)	(49)	(51)	(55)	(567)	(634)	(721)	(828)	(663)	(735)	(826)	(941)
Remainder	(208)	(230)	(258)	(286)	(134)	(167)	(191)	(215)	(755)	(799)	(855)	(909)	(1,097	(1,196)	(1,304)	(1,410)
Total Land Area	3,193	3,175	3,166	3,156	4,070	4,059	4,053	4,048	8,447	8,427	8,415	8,403	15,710	15,661	15,634	15,607
Water Surfaces[2]	73	91	100	110	71	82	88	93	100	120	132	144	244	293	320	347
Total Area	3,266	3,266	3,266	3,266	4,141	4,141	4,141	4,141	8,547	8,547	8,547	8,547	15,954	15,954	15,954	15,954
Ancillary Land Uses																
Fish & Wildlife	2,934	2,893	2,854	2,812	3,891	3,843	3,811	3,778	7,125	6,994	6,839	6,666	13,950	13,730	13,504	13,256
Water Related Recreation Facility Development	1	2	3	6	2	5	9	16	4	14	26	50	7	21	38	72
Total Irrigated Area	22	60	70	100	16	55	61	77	104	138	186	223	142	253	317	400

1/ Adjusted from Comprehensive Water and Related Land Resources Study of Puget Sound & Adjacent Waters.
2/ Includes only large water bodies over 40 acres and streams over 1/8 mile in width. Smaller water areas are included in "Other Land" category.

REGIONAL FRAMEWORK PLANS AND PROGRAMS

REGIONAL FRAMEWORK PLANS AND PROGRAMS

The regional framework plans and programs, obtained by consolidating the output of planning for the four areas, are shown by time periods in table 114. In 14 river basins or subareas, the complex nature of problems, the wide array of alternatives, or the lack of available data precluded the selection of the best plan. In those instances, the specific functional elements included in the regional framework were approximations based on judgment.

Early action developmental programs were directed toward meeting projected food and fiber needs through increased production on both irrigated and nonirrigated land and forest land; toward satisfying instream water needs for recreation, fish, power, and commerce; and toward control programs in the interest of waste treatment, watershed management, reduction of flood damages, and preservation of the natural environment.

The early action program calls for: studies to determine which streams should be preserved for recreation and fish; studies to establish minimum streamflows for environment, fish and water quality; estuary and coastline studies to establish both water and adjacent land uses; river basin studies to evaluate and weigh the alternative plans; and special studies to obtain additional facts for planning.

The long-range programs are generally the implementation of recommendations from the early action studies and continuation of the early action developmental programs.

Framework plans and programs were directed toward meeting needs based on economic projections developed from the March 1968 OBERS data as translated into functional requirements. The environmental objective was given equal consideration with economic efficiency in formulation of plans and programs. To the extent that data were available, recognition was given to requirements for recreation, fish, wildlife, and preservation of scientific, historic, and esthetic areas. Programs to satisfy environmental objectives include preservation of streams, purchase or preservation of land, establishment of parkways, scenic roads, and similar items. The regional development objective has been recognized to the extent that the plans to meet the higher levels of projected growth set forth in the Type 2 studies for Subregions 9 and 11 have been incorporated into the framework plans.

Framework programs and alternatives developed in the formulation process generally satisfy most needs. Some needs, such as reduction of flood damages, can never be reduced to zero and to this extent there are still unmet needs. Although most functional

needs are satisfied, many potential areas of conflict will need additional study to resolve the future course of action.

The following narrative describes and evaluates each component of the framework plans and programs in the order listed on table 114. The use of the word planned in this document does not imply that a fixed plan has been developed.

Summary and Evaluation

Electric Power

The load resource analysis for electric power, table 115, shows how the framework plan meets the projected requirements for firm energy and peaking capability. The plan was derived basically from the minimum hydro plan of Appendix XV, Electric Power, modified to reflect multiple-purpose projects included in the plan to meet other functional needs. For 1980, the table shows a slight surplus of peaking capability but that energy loads and resources are in balance. Considering the practicality of developing hydroelectric peaking capability as needed, it is improbable that such surplus will actually ensue. A full analysis of current data shows no surplus of peaking capability in 1980. Cooling water requirements for 2000 and 2020 are based on thermal installations which meet projected energy needs. Additional capability to meet peak loads or to cover thermal plants temporarily out of service is not identified, and its small water requirement is not derived.

Providing sufficient rights-of-way for the transmission of large amounts of power will present one of the biggest problems in meeting power loads by 2000 and beyond. To reduce environmental impacts of transmission across the Cascades, no new cross-mountain transmission corridors would be opened, but existing lanes would be reconductored to much higher capacity. Studies indicate an east to west limitation of about 22,000 megawatts north of the Columbia River and 33,000 megawatts south of the Columbia. The limit south of the Columbia includes an estimated import of 3,000 megawatts from the Klamath River Basin. In addition, 10,000 megawatts are assumed to be transmitted from coastal locations to each of the Willamette and Puget Sound Subregions, 3,000 megawatts from east of the region to the Upper Snake Subregion, and 6,000 megawatts from outside the region to western Montana. To minimize transmission distances, the logical pattern of thermal installation would call for the most capability near major load centers in the Willamette Basin and Puget Sound areas. Direct cooling for thermal plants was not acceptable, except for limited salt water cooling and for special circumstances where the cooling water would not be directly returned to the waterway.

Table 114 – Framework Plan Composition, Columbia-North Pacific Region

Purpose or Function	Units	Area A 1970-1980	Area A 1981-2000	Area A 2001-2020	Area A Total	Area B 1970-1980	Area B 1981-2000	Area B 2001-2020	Area B Total	Area C 1970-1980	Area C 1981-2000	Area C 2001-2020	Area C Total	Area D 1970-1980	Area D 1981-2000	Area D 2001-2020	Area D Total	Region Total 1970-1980	Region Total 1981-2000	Region Total 2001-2020	Region Total Total
Water Development and Control																					
Electric Power																					
Hydro	MW	3,195	5,333	0	8,528	1,283	2,309	0	3,592	49	1,555	0	1,604	101	545	0	646	4,628	9,742	0	14,370
Thermal	MW	300	2,900	7,000	10,200	0	0	0	0	1,100	22,900	54,000	78,000	2,230	14,370	39,000	55,600	3,630	40,170	100,000	143,800
(consumptive use)	1,000 Ac. Ft.	23	55	117	195	0	0	0	0	23	362	759	1,144	46 1/	214 1/	521 1/	781 1/	92	631	1,397	2,120
Peaking Resources	MW	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	300	0	26,300	26,600
Navigation																					
Locks	Number	0	3	0	3	1	0	0	1	1	1	0	2	0	0	0	0	2	4	0	6
Channels	Miles	0	57	0	57	32	0	0	32	36	106	0	142	38	162	5	205	106	325	5	436
Breakwaters	Miles	0	0	0	0	0	0	0	0	2	0	0	2	3	11	0	14	5	11	0	16
Water Quality Control																					
Raw Waste Production 2/	1,000 PE	2,089	3,332	4,562	9,983	2,105	3,825	3,966	9,896	1,279	4,345	5,276	10,900	4,798	7,320	7,965	20,083	10,271	18,822	21,769	50,862
Waste Removal 2/	1,000 PE	1,640	3,327	4,106	9,073	3,147	3,822	3,569	10,538	1,925	4,476	4,748	11,149	12,322	5,309	6,051	23,682	19,034	16,934	18,474	54,442
M&I Water Supply	MGD	117	217	265	599	108	218	257	583	281	453	637	1,371	546	1,084	1,312	2,942	1,052	1,972	2,471	5,495
Municipal	MGD	(52)	(125)	(160)	(337)	(39)	(92)	(109)	(240)	(147)	(253)	(415)	(815)	(187)	(295)	(532)	(1,014)	(425)	(765)	(1,216)	(2,406)
Industrial	MGD	(55)	(75)	(85)	(215)	(55)	(105)	(124)	(284)	(122)	(182)	(204)	(508)	(356)	(780)	(769)	(1,905)	(588)	(1,142)	(1,182)	(2,912)
Rural-Domestic	MGD	(10)	(17)	(20)	(47)	(14)	(21)	(24)	(59)	(12)	(18)	(18)	(48)	(3)	(9)	(11)	(23)	(39)	(65)	(73)	(177)
Diversions and Withdrawals	1,000 Ac. Ft.	132	241	299	672	120	244	289	653	315	507	713	1,535	615	1,215	1,476	3,306	1,182	2,207	2,777	6,166
Flood Control																					
Management Areas	Number	73	0	0	73	32	0	0	32	25	0	0	25	18	0	0	18	148	0	0	148
Major Stream Control (channels & levees)	Miles	88	83	15	186	98	26	13	137	57	296	92	445	190	207	138	535	433	612	258	1,303
Single Purpose Storage	1,000 Ac. Ft.	0	0	0	0	5	0	1	6	6	0	0	6	0	0	0	0	11	0	1	12
Irrigation																					
New	1,000 Ac.	847	320	840	2,007	1,085	390	740	2,215	566	548	444	1,558	111	64	83	258	2,609	1,322	2,107	6,038
Supplemental	1,000 Ac.	212	99	27	338	273	321	47	641	208	247	22	477	0	0	0	0	693	667	96	1,456
Diversions and Withdrawals	1,000 Ac. Ft.	3,602	1,508	2,869	7,979	4,460	1,635	2,781	8,876	2,486	1,708	1,346	5,540	215	127	196	538	10,763	4,978	7,192	22,933
Multipurpose Reservoir Storage Capacity	1,000 Ac. Ft.	875	699	666	2,240	3,669	3,366	154	7,189	2,763	2,698	1,002	6,463	947	194	50	1,091	8,154	6,957	1,872	16,983
Water and Related Land Programs																					
Fish																					
Habitat Preservation (streams)	Miles	1,890	660	470	3,020	2,810	840	570	4,220	2,670	760	520	3,950	1,750	550	360	2,660	9,120	2,810	1,920	13,850
Habitat Improvement:																					
Streams	Miles	633	853	841	2,327	4,640	3,278	3,171	11,089	3,202	6,239	7,747	17,188	490	1,250	1,063	2,803	8,965	11,620	12,822	33,407
Lakes	1,000 Ac.	34	20	29	83	14	20	20	54	33	79	92	204	34	24	23	81	115	143	164	422
Harvest:																					
Stream Access	Miles	1,041	520	796	2,357	603	710	1,018	2,331	793	780	570	2,143	1,367	657	996	3,020	3,804	2,667	3,380	9,851
Lake Access	Sites	183	93	135	411	73	96	140	309	167	153	118	438	113	54	82	249	536	396	475	1,407
Saltwater Access	Sites	0	0	0	0	0	0	0	0	20	25	20	65	77	128	202	407	97	153	222	472
Augmentation of Supply																					
Hatcheries	Number	5	6	6	17	3	3	2	8	11	13	16	40	15	21	43	79	34	43	67	144
Rearing Ponds	Acres	150	175	175	500	612	1,124	2,161	3,897	1,000	1,900	1,900	4,800	575	345	775	1,695	2,337	3,544	5,011	10,892
Wildlife																					
Land Acquisition	1,000 Ac.	548	222	374	1,144	734	402	514	1,650	234	238	193	665	137	81	92	310	1,653	943	1,173	3,769
Habitat Improvement	1,000 Ac.	1,089	1,339	1,725	4,153	833	1,673	1,327	3,833	374	507	682	1,563	160	131	253	544	2,456	3,650	3,987	10,093
Improved Hunting Access	1,000 Ac.	6,500	9,100	6,100	21,700	2,435	3,289	2,529	8,253	5,438	7,250	5,438	18,126	3,385	4,515	3,385	11,285	17,758	24,154	17,452	59,364
Augmentation of Supply																					
Game Birds	1,000 No.	138	73	111	322	45	40	69	154	22	11	16	49	74	32	49	155	279	156	245	680
Outdoor Recreation (Water Related)																					
Recreation Development	1,000 Rec. Days	7,700	20,700	37,000	65,400	8,200	20,600	35,700	64,500	17,100	34,800	62,100	114,000	16,900	56,200	104,900	178,000	49,900	132,300	239,700	421,900
Water Surface Use	Acres	12,900	68,600	125,400	206,900	11,300	40,200	71,700	123,200	42,100	85,000	151,000	278,100	102,600	285,800	505,800	894,200	168,900	479,600	853,900	1,502,400
Land Area (Rec. Facility Develop.)	Acres	7,000	7,600	17,500	32,100	6,000	8,200	15,500	29,700	18,100	20,800	42,500	81,400	14,400	17,200	34,100	65,700	45,500	53,800	109,600	208,900
Urban Land Acquisition	Acres	2,300	2,100	4,100	8,500	1,600	3,300	5,900	10,800	5,300	10,400	22,600	38,300	5,400	11,600	23,300	40,300	14,600	27,400	55,900	97,900
Boat Launch Areas	No. of lanes	42	422	775	1,239	87	219	453	759	368	1,065	1,919	3,352	213	653	1,142	2,008	710	2,359	4,289	7,358
Related Land Programs																					
Nonstructural:																					
Erosion and Sediment Control	1,000 Ac.	1,485	2,840	2,194	6,519	4,431	6,303	6,091	16,825	1,784	2,783	3,212	7,779	205	369	372	946	7,905	12,295	11,869	32,069
Water Conservation	1,000 Ac.	949	315	812	2,076	1,075	364	715	2,154	544	506	455	1,505	120	67	81	268	2,688	1,252	2,063	6,003
Protection and Management	1,000 Ac.	26,007	25,941	25,950	NA	30,128	22,529	22,051	NA	26,847	26,127	27,297	NA	12,762	12,673	11,982	NA	95,744	87,270	87,280	NA
Water Yield Improvement	1,000 Ac.	52	95	97	244	39	51	56	146	20	32	57	109	6	54	53	113	117	232	263	612
Structural:																					
Drainage	1,000 Ac.	54	89	83	226	123	112	139	374	142	186	189	517	61	92	77	230	380	479	488	1,347
Trib. Stream Control (Flood Control)																					
Bank Stabilization	Miles	1,539	1,819	1,330	4,688	1,272	3,191	2,245	6,708	1,246	1,498	1,457	4,201	486	525	508	1,519	4,543	7,033	5,540	17,116
Dikes and Levees	Miles	154	148	117	419	298	504	590	1,392	477	652	654	1,783	174	262	259	695	1,103	1,566	1,620	4,289
Channel Improvement	Miles	2,640	3,309	3,251	9,200	1,949	3,332	2,948	8,229	2,807	2,741	2,183	7,731	1,037	1,240	1,088	3,365	8,433	10,622	9,470	28,525
Erosion Control Structures	Number	3,467	3,831	3,972	11,270	22,200	28,800	23,300	74,300	5,148	9,223	6,810	21,181	288	1,034	1,745	3,067	31,103	42,888	35,827	109,818
Ponds and Small Reservoirs	Number	459	839	609	1,907	13,600	15,770	18,230	47,600	4,250	6,641	6,021	16,912	660	1,010	1,325	2,995	18,969	24,260	26,185	69,414
	1,000 Ac. Ft.	75	77	37	189	44	82	67	193	36	49	33	118	11	11	9	31	166	219	146	531
Studies																					
Coastal Zone and Estuaries:																					
Estuarine Management	No.	0	0	0	0	0	0	0	0	22	0	0	22	7	0	0	7	29	0	0	29
Estuarine Management	1,000 Ac.	0	0	0	0	0	0	0	0	57	0	0	57	1,733	0	0	1,733	1,790	0	0	1,790
Beach Management	Miles	0	0	0	0	0	0	0	0	256	0	0	256	227	122	0	349	483	122	0	605
Beach Stabilization	Miles	0	0	0	0	0	0	0	0	64	102	0	166	7	91	0	98	71	193	0	264
River Basin	No.	6	0	0	6	6	0	0	6	2	0	0	2	0	0	0	0	14	0	0	14
Watersheds	No.	130	110	0	240	151	105	0	256	119	65	0	184	158	58	0	216	558	338	0	896
Special:																					
Preservation of Streams	Miles	2,170	0	0	2,170	3,524	0	0	3,524	3,111	0	0	3,111	1,754	0	0	1,754	10,559	0	0	10,559
Scenic Roads	Miles	2,010	0	0	2,010	1,168	0	0	1,168	2,898	0	0	2,898	1,404	0	0	1,404	7,480	0	0	7,480
Roadless Areas	1,000 Ac.	553	0	0	553	1,172	0	0	1,172	355	0	0	355	614	0	0	614	2,694	0	0	2,694
Minimum Flow	No.	14	0	0	14	1	0	0	1	1	0	0	1	1	0	0	1	17	0	0	17
Other	No.	9	0	0	9	0	0	0	0	6	0	0	6	2	0	0	2	17	0	0	17

1/ Salt water use data deleted.
2/ Includes municipal, industrial, and recreation use.

Table 115 - Electric Power Load Resource Analysis
Columbia-North Pacific Region

Areas	1970 Existing	1970 Under Const.	1970 Nameplate Capacity	1970-1980	1980 Nameplate Capacity	1980 Firm Energy	1980 Dependable Capacity	1980-2000 2/	2000 Nameplate Capacity 2/	2000 Firm Energy	2000 Dependable Capacity	2000-2020	2020 Nameplate Capacity	2020 Firm Energy	2020 Dependable Capacity
								(1,000 mw)							
Area A															
Hydro	8.2	3.1	11.3	3.2	14.5	6.5	14.8	5.3	19.8	6.3	20.7	0.0	19.8	6.3	20.7
Thermal	0.8	0.0	0.8	0.3 1/	1.1	1.0	1.1	2.9	4.0	3.4	4.0	7.0	11.0	9.4	11.0
Area B															
Hydro	2.0	1.4	3.4	1.3	4.7	2.0	4.9	2.3	7.0	2.1	7.7	0.0	7.0	2.1	7.7
Thermal	negl.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Area C															
Hydro	5.3	1.5	6.8	0.0	6.8	3.4	7.5	1.6	8.4	3.4	9.2	0.0	8.4	3.4	9.2
Thermal	0.2	0.0	0.2	1.1	1.3	1.1	1.3	22.9	24.0	20.4	24.0	54.0	78.0	66.3	78.0
Area D															
Hydro	2.1	negl.	2.1	0.1	2.2	0.9	2.2	0.5	2.7	1.0	2.7	0.0	2.7	1.0	2.7
Thermal	0.3	1.4	1.7	2.2	3.9	3.3	3.9	14.4	18.0	15.3	18.0	39.0	57.0	48.4	57.0
Region															
Hydro	17.6	6.0	23.6	4.6	28.2	12.8	29.4	9.7	37.9	12.8	40.3	0.0	37.9	12.8	40.3
Thermal	1.3	1.4	2.7	3.5	6.3	5.4	6.3	40.2	46.0	39.1	46.0	100.0	146.0	124.1	146.0
Thermal Reserve 3/	-	-	-	-	-	-	-	-	9.6	8.2	9.6	-	28.0	23.8	28.0
Imports	-	-	-	-	-	0.5	0.2	-	8.0	6.8	8.0	-	12.0	10.7	12.0
Peaking Resources 4/	0.0	0.0	0.0	0.3	0.3	0.0	0.4	0.0	0.3	0.0	0.4	26.3	26.6	-0.3 5/	30.6
Total	-	-	-	-	34.8	18.7	36.3	-	101.8	66.9	104.3	-	250.5	170.6	256.9
Loads (Including Reserves)	-	-	-	-	-	18.7	33.8	-	-	66.6	102.3	-	-	170.6	256.9

1/ Net reflects discontinuation of operation of Hanford No. 1.
2/ All existing small thermal plants assumed to be retired by 2000, gross increments shown.
3/ Base load thermal installation, not included in subregional breakdown as they will not add to cooling water requirements.
4/ Pumped storage, gas turbine, and/or other types of peaking plants.
5/ Net energy loss required to support pumped-storage peaking plants.

On the basis of present technology, most thermal developments in the near future would be light water nuclear reactors. Sometime between 1980 and 2000, liquid metal breeder reactors would become feasible and subsequent plants would be that type By 2020, many of the earlier light water reactors will have been replaced by the more advanced LMB reactors.

The light water reactors would require, for each 1,000 mw of capacity, an average annual flow of 1,380 cfs for direct cooling, 29.2 cfs for evaporative cooling, or a cooling pond of 1,700 acres at a depth of 10 to 20 feet. The more advanced breeder reactors would require only 1,000 cfs or 23.4 cfs, respectively for the same capacity. On this basis, the annual consumptive use of water would be 746,000 acre-feet by 2000 and about 2.1 million acre-feet by 2020.

Siting guidelines followed by a general survey are needed to define areas suitable for thermal plants.

The plan identifies means for meeting all projected needs, although the details of satisfying peaking loads will require further study.

Satisfaction of the projected needs would accomplish the regional development objective. The bulk of the new hydro capacity, which consists of additions to existing plants, was selected on the basis of the most economical and practicable units; consequently, the economic efficiency objective is satisfied. By adding most of the new hydro capacity at existing plants and making maximum use of existing transmission corridors, environmental impacts would be minimized. Thermal plant locations would require additional study to minimize their impacts. A plan to meet the regional development objective would require additional generating capacity in each time period and probably would have more plants in the area west of the Cascades to minimize transmission costs as well as satisfying additional peaking capability.

Conversely, an environmental objective that envisioned a lesser degree of development would require less power and fewer powerplants. Every effort has been made to minimize environmental impacts while meeting the needs. To this extent the plan is compatible with the environmental objectives. However, each cooling tower would emit a plume of condensed cool steam into the atmosphere and any heat injected into the salt water could have significant, though not necessarily detrimental, effects on local ecosystems.

Navigation

Foreign and domestic coastwise waterborne commerce is forecast to increase from about 45 million tons in 1968, to almost 200 million tons in 2020. Internal commerce is projected to increase from about 52 million tons in 1968, to over 190 million tons in 2020. These are shown graphically in figure 27. Waterborne commerce is forecast to increase from 11.5 million tons in 1968, to 20.1 million tons in 2020 on the Columbia-Snake system, and from 5.3 million tons in 1968, to 13.2 million tons in 2020 on the Willamette waterway.

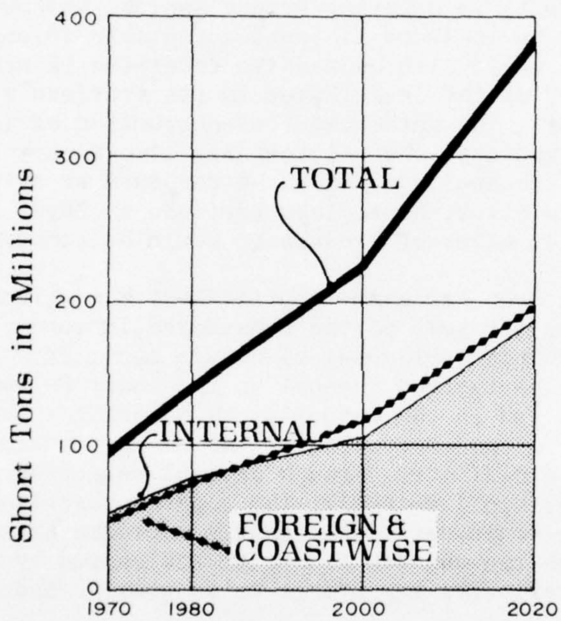


FIGURE 27. Projected Annual Waterborne Commerce, Columbia-North Pacific Region

Projects which have been identified to assure these movements are shown by area and time period on table 114, Framework Plan Composition. To the extent that there is increased marine traffic, either commercial or recreational, on the navigable waters of the United States, there will be requirements for more aids to navigation, search and rescue services, law enforcement, and other related activities by the U. S. Coast Guard. These services will be provided on a level consistent with national priorities. It should be observed that there will be requirements for like services from local jurisdication at least in non-Federal waters.

The framework plan for the 1970-1980 period includes completion of the lock and 32 miles of channel at Lower Granite Dam, and enlargement of Bonneville lock to at least equal the size of the upstream locks, and improvement of the approaches thereto. In the Oregon coastal area, 36 miles of channel would be improved and 2 miles of breakwater constructed to aid navigation conditions at Coos Bay, Siuslaw River, and entrance of Rogue River. In Washington, 38 miles of channel would be deepened or extended in Grays Harbor and the Puget Sound area and 3 miles of breakwater at Grays Harbor would be rehabilitated.

In the 1980-2020 period, a project comprising 57 miles of intermittent channel deepening below Priest Rapids Dam and the installation of locks in existing Priest Rapids, Wanapum, and Rock Island Dams would be included if found acceptable through further studies. Studies would also be made to determine if navigation should be extended up the Snake River to its confluence with the Grande Ronde River. The authorized reconstruction of locks at Willamette Falls and open channel work are also a part of the plan. Some 162 miles of channel would also be deepened or extended along the lower Columbia River, at Willapa Bay, and in Puget Sound and adjacent waters; 11 miles of breakwater would be constructed.

Navigation does have some conflicts with environmental quality objectives and some of the considered improvements could cause further problems. Disposal of dredge spoil from maintenance of the deep draft navigation channel in the lower Columbia and Willamette Rivers and in the estuaries is becoming a problem in some areas which further deepening of the channel would compound. The problem can be minimized through careful selection of disposal areas. Except for spoil disposal, the deeper channels needed for future navigation would not significantly increase environmental problems, although the changed flow patterns caused by altered hydraulic characteristics may affect water quality and aquatic life.

Another conflict with the environmental objective is the pollution caused by dumping garbage and washing bilges at sea. These practices must be controlled and greater care is needed to prevent accidental spills of petroleum.

The navigation elements would meet economic efficiency objective. The regional development also would be satisfied with only minor modification of the time schedule.

Water Quality Control

Raw wastes loading from recreational, municipal, and industrial sources and the planned reduction of wastes through treatment are illustrated in figure 28. Although raw waste

production is expected to reach 95 million population equivalents in 2020, treatment will reduce the discharge to a waste equivalent of about 16 million people.

The treatment called for is 85 percent removal of oxygen demanding wastes by 1980 and 90 percent thereafter. The only exception would be for treatment of wastes discharged in the deep marine waters of the Puget Sound Subregion, where primary treatment with 35 percent to 45 percent removal was deemed adequate to meet State standards. An accelerated program of treatment is required to meet the water quality goals.

Federal and State authorities are reviewing present waste treatment requirements in the Puget Sound area. These study findings will become the basis for future treatment requirements.

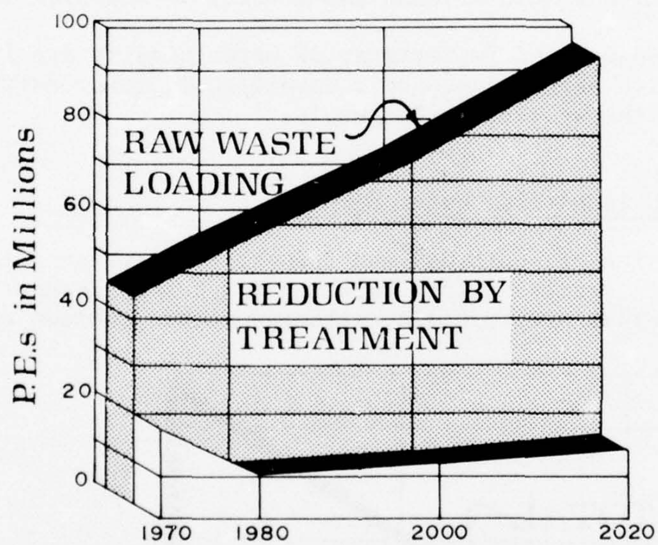


FIGURE 28. Raw Waste Loading and Planned Reduction, Columbia-North Pacific Region

Minimum flows compatible with the accepted levels of treatment are required to assimilate residual wastes and insure water quality suitable for withdrawal and instream uses. Livestock wastes also would be controlled to prevent their entry in water of the region.

Water quality management programs are based on meeting inter and intrastate standards established by the Federal Government and the States. If these are accomplished, the environmental quality, well-being of people, and regional development objectives will be met. A healthful environment, of which water is a major component, will improve the ability of regional industries to attract and hold a stable work force. High quality waters are also essential to many industries, including food processing and pulp and paper, which are major components of the regional industrial mix.

Runoff and return flow from agricultural land can carry excessive nutrients if their is a heavy sediment load. Salt is a problem in only a few minor streams. The extensive land treatment, management, and water conservation practices included in the plan would reduce this problem materially despite the increase in irrigated land and more intensive land use. Where problems develop, studies should be made and corrective measures implemented.

Maintenance and improvement of water quality are in consonance with national economic development, environmental quality, and the well-being of people.

Municipal and Industrial Water Supply

Provision of municipal and industrial water supplies is programed on a fairly uniform basis to match demands and no critical problems are foreseen, although local problems may occur

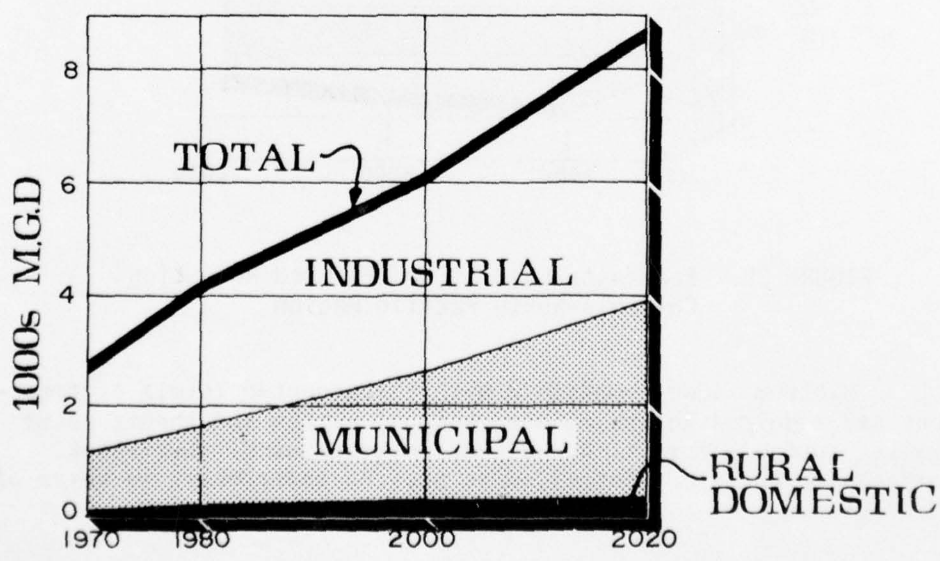


FIGURE 29. Municipal and Industrial Water Requirements, Columbia-North Pacific Region

in several locations. Total water supply requirements by 2020 are about 8,624 MGD or 2.8 times the present use. This requires a 2020 withdrawal of 9.7 million acre-feet per year. Figure 29 illustrates the municipal, industrial, and rural-domestic requirements. Planned water supply programs fully satisfy these needs.

The objective of the region's municipalities, industries, and individual water purveyors is to develop satisfactory water supply systems geared to meet these needs. The planning objectives, regional development, and economic efficiency, require adequate municipal and industrial water supplies. Water is generally available to meet future needs, and satisfying these needs is not expected to conflict with environmental quality objectives in most areas. Both surface and ground-water sources could be depleted in some areas, however, with accompanying adverse impacts on quality. Careful consideration of all factors in selecting and developing future supplies will be required to minimize or avoid these impacts.

Flood Control

The objective of flood control is to attain proper use of all flood plain areas consistent with the needs of the region, the potential of each flood plain area, and the practicability of providing protection.

A general criteria was adopted to provide structural protection up to floods of standard project magnitude whenever reasonable. Where structural protection is provided, urban and suburban areas would be protected to no less than 100-year floods and rural areas in which homes are located to no less than 25-year.

The flood control program is a mix of nonstructural and structural measures. Zoning and regulation are proposed for nearly all flood plains to assist in reducing future flood damages by encouraging appropriate use of flood plain areas and by restricting other uses.

Effective flood plain regulation programs, adopted now throughout the region and vigorously enforced through 2020, would prevent more than 15 percent of the damages projected to occur at that time along major streams. The programs appeared necessary in 73 management units in Area A, and 32, 25, and 18 in Areas B, C, and D, respectively. In most areas the program would be administered on a county basis.

Structural measures would consist of 1,303 miles of levees and minor channel improvement, 12,000 acre-feet of single-purpose flood control storage, and use of several million acre-feet of multiple-purpose storage. The 1970-1980 period includes 433 miles

of channels and levees and 11,000 acre-feet of exclusive flood control storage. The middle period includes 612 miles of channels and levees, and the last period 258 miles plus 1,000 acre-feet of exclusive storage. The multiple-purpose storage is listed on table 114, Framework Plan Composition.

Flood control needs for this study have been expressed as average annual damages, 1967 dollar value. Accomplishments are measured as damages prevented.

Flood damage categories, shown in table 40, Needs Summary, are: major streams, bank erosion, and minor streams. The only evaluation made of flood damage reduction provided by the plan pertains to major streams. Damage reduction along major streams would be accomplished through the use of flood plain management, flood proofing, channel improvements, levees, and storage. Planned reduction of damages is shown in table 116.

Table 116 - Planned Reduction of Flood Damages, Major Streams
Columbia-North Pacific Region

Area	1980		2000		2020	
	$1,000	Percent	$1,000	Percent	$1,000	Percent
A	3,205	59	7,012	67	15,250	73
B	1,356	35	2,616	44	4,465	45
C	6,863	46	17,350	67	33,444	70
D	9,438	67	19,420	80	39,802	88
Region	20,862	54	46,398	70	92,961	75

Significant reductions in bank erosion damages and in flood damages along minor streams would also be provided by measures included in this and the land measures programs, although these reductions were not evaluated in terms of dollars.

The environmental, economic efficiency, and regional development objectives can all be best satisfied by a combination of nonstructural and structural programs.

Future flood damages can be curtailed through proper and timely utilization of flood plain regulations. Development that is not allowed in the flood plain can usually be located in a nearby floodfree location and thus not be lost to the particular general area.

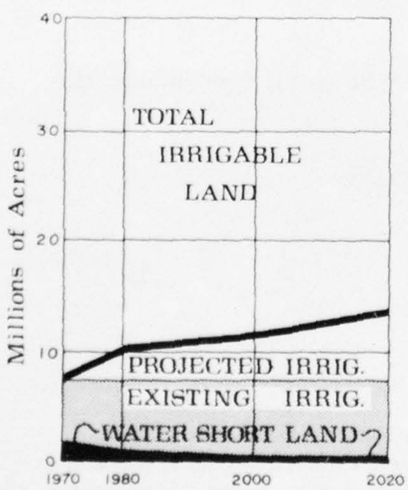
Control of flooding, in itself, enhances the environment. With careful planning of flood control structures, most conflicts

with the environmental objective can be avoided. However, when reservoir storage is utilized, there is always a certain loss of land and free-flowing streams. These factors were carefully analyzed and evaluated when considering storage projects. As a result, several potential large storage projects were omitted.

The regional development objective is reflected in Subregions 9 and 11 through utilization of the higher projections contained in the comprehensive water and related land resource studies of the Willamette River Basin and Puget Sound and Adjacent Waters.

Irrigation

The fundamental need to increase food and fiber production would be met through higher yields and some increase in cropland area. After allowing for increased yields expected from improved management and new crop varieties, it was estimated that the irrigated cropland acreage would have to increase by 6 million acres between 1970 and 2020 if production needs are to be met. In addition, the nearly 2 million acres of currently irrigated, water-short lands would have to be furnished a full water supply. Together these would require that annual irrigation water deliveries increase by about 23.6 million acre-feet. The projected irrigation land and water requirements are illustrated in figure 30.



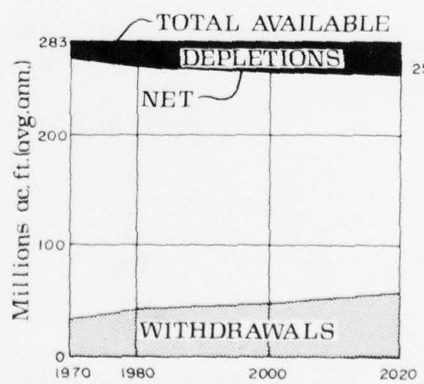


FIGURE 30. Projected Irrigation Land and Water Needs, Columbia-North Pacific Region

The framework plan includes the development of over 6 million acres of new irrigation but would only provide supplemental water to about 1.5 million acres, or 74 percent, of the water-short land. Irrigation needs and plan accomplishments are compared in table 117.

Table 117 - Irrigation Needs and Plan Accomplishments
Columbia-North Pacific Region

Item	1970-1980	1980-2000	2000-2020	Total
		(1,000 acres)		
Needs				
New	2,595	1,298	2,107	6,000
Supplemental	1,970	0	0	1,970
Plan Accomplishments				
New	2,609	1,322	2,107	6,038
Supplemental	693	667	96	1,456
Difference				
New	+14	+24	0	+38
Supplemental1/	-1,277	+667	+96	-514

1/ Minus values represent acres of land deficient in water.

Supplemental water needs would not be satisfied under the plan for the following acreages:

Subregion	1,000 Acres
4	138
5	251
7	14
10S	29
12	82
Total	514

One of the adopted criteria for meeting food and fiber needs was that all supplemental water needs would be met during the 1970-80 period. However, in formulating the plan, it became evident that in some areas additional water was unavailable or its development was not practicable. Also, there were water-short areas where providing supplemental water would only be practicable in conjunction with developing new lands which did not always conform to needs or logical development in the early time frame. As a result of these situations, some of the projected supplemental

AD-A036 571 PACIFIC NORTHWEST RIVER BASINS COMMISSION VANCOUVER WASH F/G 8/6
COLUMBIA-NORTH PACIFIC REGION COMPREHENSIVE FRAMEWORK STUDY OF --ETC(U)
JUN 72 E J GULLIDGE, H H RALPHS, C STEWART

UNCLASSIFIED NL

7 OF 7
AD
A036571

END
DATE
FILMED
8-77

water needs would not be met until after 1980 and others could not be met at all. In Area C (Subregions 7, 9, 10S, and 12), a practicable supplemental supply could not be identified for some 125,000 acres of water-short land. However, there are additional irrigable lands in the area for which water could be provided. It was estimated that the production deficiency could be made up by irrigating 37,000 acres of dry land. This additional new irrigation was included in the plan and accounts for most of the apparent excess of new irrigated land.

No attempt was made to estimate the increase in new irrigation required in Area B (Subregions 4 and 5) to compensate for the inability to supplement water supplies for 389,000 water-short acres. An undetermined amount of this shortage could be made up by increased onfarm efficiency and water savings. However, most of the lack of production would have to be compensated for by additional new irrigation, if not in the Snake River Basin, then in some other part of the region where there are ample supplies of water and irrigable land. An extra 1,000 acres of new irrigation were included in Area B to partially make up for the shortage.

Although the plan does not include sufficient irrigation development to fully meet projected food and fiber needs, there is ample irrigable land and water to accomplish it, satisfying both the economic efficiency objective and the regional development objective.

The environmental quality objective was considered throughout the formulation of plans to meet the irrigation need. Both positive and negative effects are inherent in any development. In areas of high scenic and recreation value, such as the Jackson Hole-Teton-Yellowstone and Salmon-Clearwater areas, development would be minimized. Developments on potential wild and scenic rivers would be avoided until studies of the potentials are completed. Where storage would be required, additional capacity would be included to alleviate flooding and to improve low flows and their quality. However, some storage and diversions could reduce streamflows to less than optimum, block wildlife migration routes, or flood out critical winter habitat. At the same time, the irrigated cropland could enhance habitat for wildlife while providing needed food and fiber, certainly a major enhancement of the environment. Also, new storage would provide additional lake-type fishery and additional recreation water surface.

Multiple-Purpose Reservoir Storage

Almost every major stream is controlled to some degree by storage dams. There are 194 reservoirs with storage capacities of 5,000 acre-feet or more with a combined active storage volume of

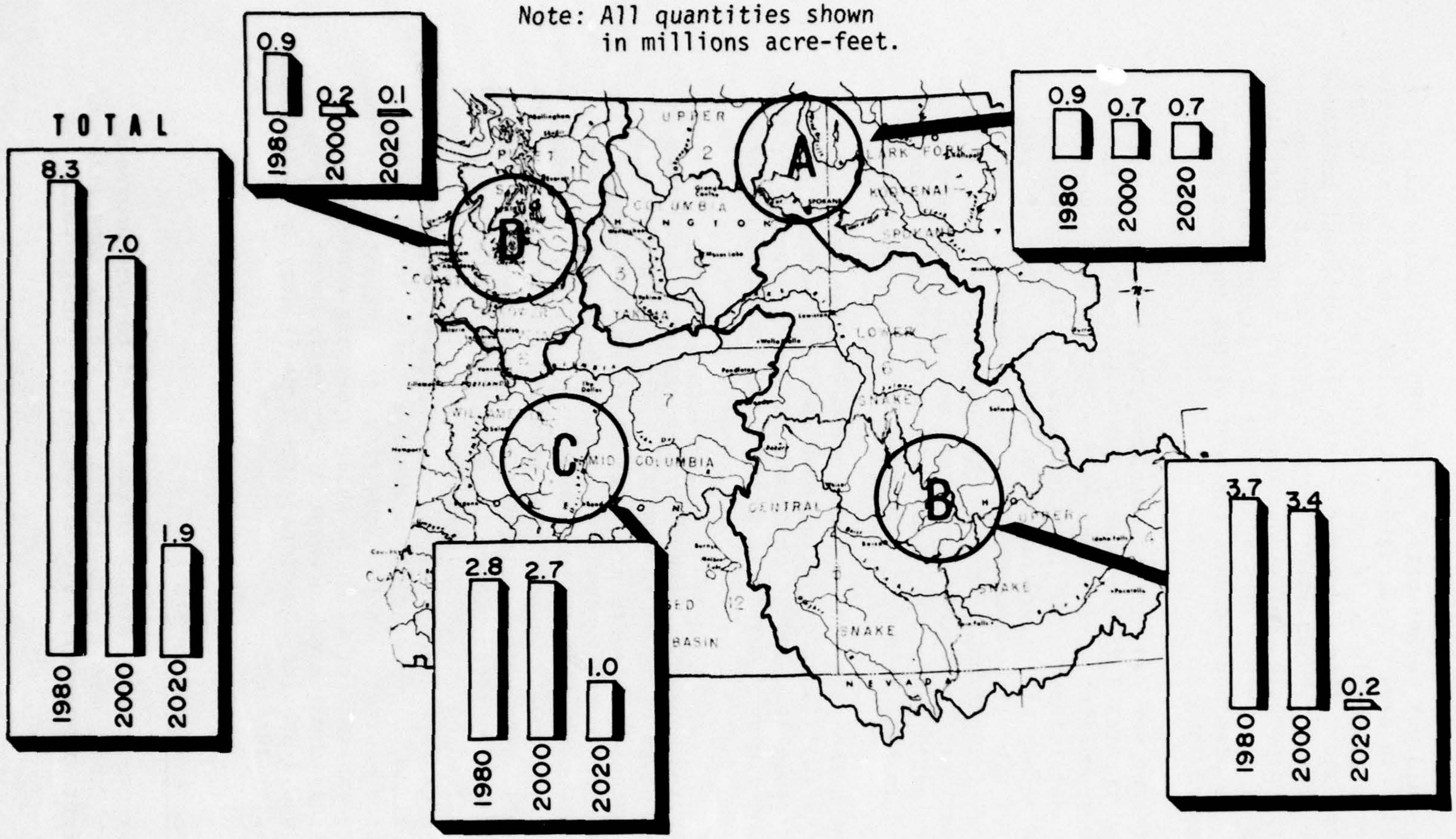


FIGURE 31. Planned Reservoir Storage, Columbia-North Pacific Region

40 million acre-feet. Also there are about 26,000 small reservoirs of lesser size which store 400,000 acre-feet.

Figure 31 provides a graphical distribution of planned multiple-purpose reservoir storage by time period in the four areas. The total additional storage by 2020 could be about 17 million acre-feet. In most cases, the storage would: (1) provide water supplies for irrigation, (2) control floods, (3) provide municipal and industrial water supplies, (4) furnish water bodies for general recreation and fishing, and (5) increase low streamflows to improve water quality.

About one-third of this potential storage lies in river basins or subareas which require further study to select the best plan from an array of alternatives. Most of those sites are highly controversial because of their environmental impact.

Fish and Wildlife

Regional fish and wildlife needs have been projected to increase by 283 million pounds of commercial fish harvest, nearly 43 million sport fishing days and over 13 million hunter-days, by 2020. Total needs for sport fishing and hunting days throughout the 1970-2020 period are shown in figure 32.

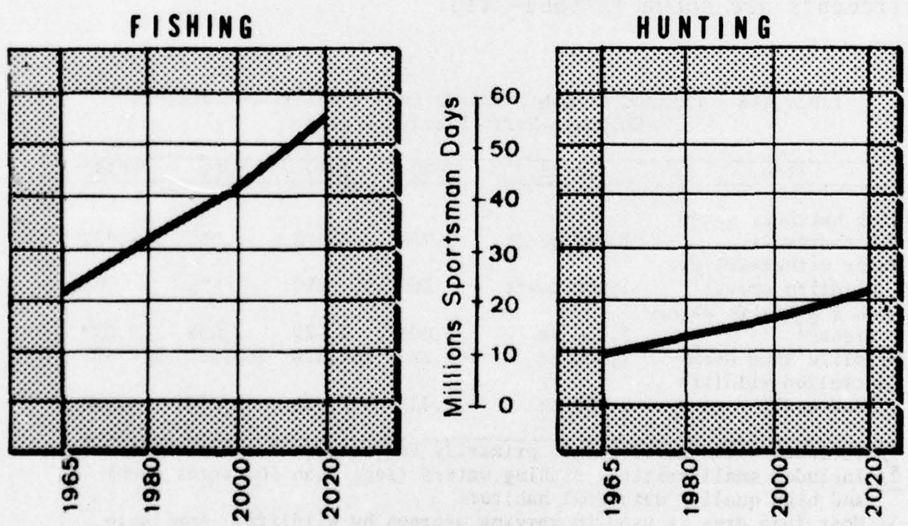


FIGURE 32. Projected Sport Fishing and Hunting Needs, Columbia-North Pacific Region

The plans and programs to satisfy the projected needs would be oriented largely toward preserving and upgrading the available habitat and improving sportsman access to it. A considerable amount of habitat preservation is included in the recreation program which includes studies to identify lands and streams which should be preserved in their natural condition. Habitat preservation in other areas would be accomplished, as provided in the plan for other functions, by avoiding developments to the extent possible in prime or critical fish and wildlife areas.

Nearly 3.8 million acres for wildlife would be acquired, habitat improved on over 10 million acres, and hunting access provided to over 59 million acres. Game bird numbers would be augmented through game farm production that would amount to an additional 680,000 birds annually by 2020.

Fish habitat preservation would involve nearly 14,000 miles of stream. In addition, current fish populations would be augmented through construction of, or additions to, 144 fish hatcheries and nearly 11,000 acres of rearing ponds. Habitat improvements would be carried out on 33,400 miles of stream and 422,000 acres of lakes. Increased fish harvest would be accomplished by improving access to nearly 10,000 miles of stream, at 1,400 sites on lakes at over 470 sites on salt water. Significant land and water requirements associated with fish and wildlife plan requirements are shown in table 118.

Table 118 - Planned Fish & Wildlife Land & Water Requirements
Columbia-North Pacific Region

Item	Units	1970	1980	2000	2020
Fish hatchery water withdrawals	1,000 ac-ft	2,729	3,373	4,005	5,423
Water withdrawal for wildlife areas1/	1,000 ac-ft	209	356	505	602
Fish & wildlife water areas2/	1,000 ac	2,003	2,029	2,055	2,073
Wildlife land use3/	1,000 ac	165,393	164,324	163,331	162,321
Controlled wildlife land use4/	1,000 ac	1,423	2,631	3,237	4,088

1/ Includes water developments primarily for waterfowl enhancement.

2/ Includes small critical fishing waters (less than 500 acres each) and high quality waterfowl habitat.

3/ Most land area is used in varying degrees by wildlife. Available lands will slowly be reduced by infringement of urban and industrial areas, development of special use areas, and increased reservoir water areas, despite requirements for enhancement of wildlife resources and increasing hunting demand.

4/ Lands operated or owned and managed by fish and wildlife agencies specifically for wildlife control and enhancement.

No procedure was devised for making a mathematical comparison between needs, in terms of pounds of fish or sportsman-days, and the elements included in the plan. However, in the judgment of the State and Federal agency personnel responsible for fish and wildlife aspects of the plan, as a minimum all of the elements included are necessary to meet the needs and would, in their estimation, satisfy projected needs. In many instances, even with the planned program, the quality and success of future hunting or fishing will not be as high as it is today. Fish and wildlife use all suitable land and water in the region. Consequently, any conversion to noncompatible uses represents a loss of habitat. In other instances, the conversion of habitat use may generate a different type of fish or wildlife that may or may not be desirable. The plan for fish and wildlife takes into account these shifts, offsets losses where practicable, and augments natural production to the extent practicable, consistent with the projected need. Additional study and evaluation will be required to arrive at a system, other than judgment, that will permit converting needs in terms of human use into meaningful fish and wildlife equivalents.

The fish and wildlife plan elements, to the extent permitted by an assessment based on judgment, meet the projected needs for pounds of commercial fish and sportsman use. Consequently the economic efficiency objective for the region is satisfied, and, in the Puget Sound and Willamette subregions where local projections greater than OBERS (representing the regional development objective) were used, it is exceeded. The regional development objective is satisfied throughout. Most plan elements are compatible with the environmental quality objectives. This is especially true of those items involving preservation of habitat, and, in most instances, habitat improvement. However, special care will be required in providing additional sportsman access, introduction of new species, habitat improvements, and management practices to assure that they make beneficial contributions to environmental quality or that any necessary negative effects are minimized. A thorough evaluation will require considerable more basic data and knowledge than are currently available and a careful assessment of unproved innovations.

In addition to the satisfaction of hunting and fishing needs, the plan elements for preservation and protection of fish and wildlife include the preservation of rare and endangered species.

Recreation

Water related recreation, one of the fastest growing uses of water in the region, is projected to increase 421.9 million recreation days from 89.3 million to 511.2 million by 2020, a growth of nearly 470 percent. In terms of water surface and associated land needs, this will require the use of nearly 1.9

million acres of water surface and recreation facility development on 240,000 acres of land by 2020. The region's existing water area comprises about 2.5 million acres of fresh water and over 2,500 square miles of salt water in bays and estuaries, much of which is in the Puget Sound area.

The framework plan includes two basic programs to satisfy the additional outdoor recreation need. One involves preserving and maintaining existing resources so they are available in the future; the other is concerned with developing the resources within their capacities to support the increasing use.

The plan provides for additional recreation use of about 1.5 million acres of water surface, facility development on 209,000 acres of associated land, and acquisition of 98,000 acres for recreation development by 2020. These acquisitions and developments would be carried out as both population and leisure time increase. The projected growth of recreation needs is shown in figure 33.

The large reservoirs on the Columbia now could absorb much of the projected demand in the central part of the area and could become a major alternative to recreational developments elsewhere. Interdisciplinary studies are recommended to select the best plan

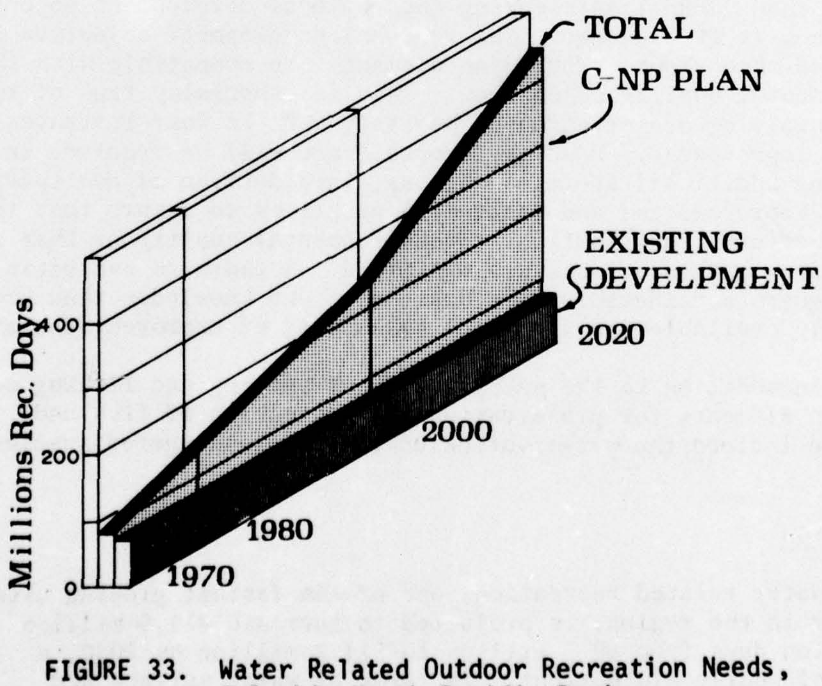


FIGURE 33. Water Related Outdoor Recreation Needs, Columbia-North Pacific Region

for the river for long-range public needs; recognizing the possible conflicts between power and navigational use, and the preservation and utilization of natural environmental values. These studies should establish the effect of various levels of peaking operations and develop an overall plan for future use of the river and its related lands.

Thermal plants which will gradually supply a greater proportion of future base electric load are potential recreational opportunities. Each of the thermal plant proposals would be thoroughly investigated and optimum use made of these developments for recreation purposes.

The plan includes a system of wild, scenic, and recreation rivers; picnicking, swimming, boating, water skiing, sightseeing, hiking, and camping areas; and related facility developments. Special emphasis would be given to increasing facilities near urban centers where the need will be greatest.

Boating, which encompasses sport fishing and water skiing, is one of the major recreation activities of the region and would use a large part of the present water surface as well as new water areas provided for in the plan. The number of pleasure craft is projected to increase from 423,000 in 1970 to 2.2 million by 2020. This activity would require associated land for access, parking, etc., and some 7,400 additional boat launching lanes. All of these have also been included in the plan.

Also included are numerous additional studies of free flowing rivers, scenic roads, and roadless areas to identify those which should be formally recommended for preservation and protection.

Overall, the framework plan provides for meeting all of the identified water-related recreation needs. However, within the Willamette Subregion the needs are not fully satisfied with regard to the location of available and planned water surface in relation to the large population of the Portland area. In this instance, a portion of the recreationists from Portland would have to travel to the middle part of the subregion to reach ample water and facilities.

The plan elements for water-related recreation meet the projected needs and consequently satisfy the national economic efficiency objective for the region; in the Puget Sound and Willamette Subregions, where projections representing regional development objectives were used, they are exceeded. The regional development objective is satisfied throughout.

Most recreation plan elements are consistent with the environmental quality objective, particularly those involving

stream and greenbelt preservation, protection of natural and historic areas, and establishment of scenic roads. However, particular attention will have to be given to the construction of recreation facilities to insure their compatibility with environmental considerations.

Related Land Program

Related land programs comprise many structural and nonstructural measures applied to crop, range, and forest lands. The principal nonstructural measures have been combined under four headings: erosion and sediment control, water conservation, protection and management, and water yield improvement. All but the last are continuations of ongoing programs and reflect only moderate increases over current efforts. Water yield improvement is not an ongoing program, but the planned program is not large.

Structural programs, which have many different forms and uses, have been aggregated into the primary categories of drainage, tributary stream control, erosion control structures, and ponds and small reservoirs. Because of its importance and magnitude, the item of tributary stream control has been further divided into programs of bank stabilization and levees, which are primarily directed toward reducing bank erosion and overbank flooding. A major amount of channel improvement is located on forest land and includes removal of debris and logs, installation of riffles and resting pools, primarily in the interest of fish, wildlife, and water quality improvement. The need for these three structural programs for minor tributaries during the first 10-year period exceeds the current totals by from over 100 to over 200 percent (figure 34). Additional watershed studies are required

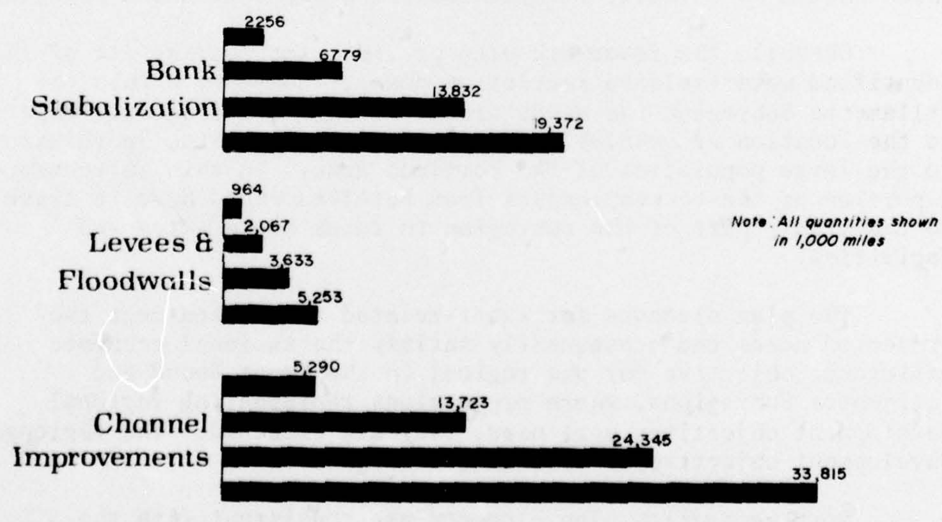


FIGURE 34. Watershed Improvements, Structural Works, Columbia-North Pacific Region

to select those areas that are economically feasible for development and, at the same time, best utilize the opportunities to enhance fish and wildlife habitat. These studies are scheduled for completion during the first two time periods.

The primary objective of the land measures and watershed protection programs is to protect and improve watershed environment in conjunction with intensive, wise, efficient, and multiple use of land and water resources. These programs would allow safe optimum use of the land as productivity is increased to meet food and fiber needs, and as the demand for other uses increases. Thus, if the proposals as advanced in the framework plans were implemented as programed, the needs of the economic efficiency objective would be satisfied.

These accomplishments could be accelerated to help meet the regional development objectives. The proposed measures and practices would improve water quality, conserve water, reduce erosion, sediment, and flood damage while substantially improving the land and water resources. Generally they would also improve, restore, or preserve quality environment while other objectives are being met. Some watershed conditions would require measures having a detrimental effect on the environment. However, emphasis would be placed on watershed improvement and protection through improved management techniques or forms of land treatment which would not cause disturbance to the landscape and would frequently improve or restore environmental aspects such as wildlife habitat, water quality, and esthetic values.

To illustrate how the recommended means to satisfy needs affects environment, food and fiber, regional development, and good of the people, the following results are estimated by 2020. In cropland areas, erosion problem areas would be decreased from 5.8 million acres to 1.6 million acres, and sediment yield is expected to drop from 17,800 acre-feet annually to 6,600 acre-feet (a 63 percent reduction). Cropland drainage problem areas would be reduced from 1.7 million acres to 700,000 acres. Flood damages would be significantly reduced, and improved water management techniques would make more efficient use of water for irrigation and other uses.

Increased needs for forest products would be met by increased levels of watershed protection and more intensive management practices, and streamflows would be improved by vegetative cover manipulation and snowfield management. Forest lands would provide increased game habitat and recreation values along with more wood fiber production, an estimated increase from 4.3 billion to 5.3 billion cubic feet annually. Water yields would be more even and the annual sediment yield would be decreased from 9,200 acre-feet to 7,900 acre-feet (a 15 percent reduction).

The need for greater forest production from a decreasing land base has potential for serious conflict with the environmental objective. Very careful timber management and harvesting practices must be employed to minimize adverse environmental impacts.

Range areas with major erosion problems would be reduced from about 8.9 million to 2.1 million acres and annual sediment yields are expected to drop from 11,200 to 6,100 acre-feet (a decline of 45 percent). Good condition rangelands would be increased from 11.6 million acres or 20 percent of all rangeland to 40.7 million acres or 72 percent of the total by 2020. Range grazing capacity would be increased from 7.3 million animal unit months to 11.8 million animal unit months (a 63 percent increase). This would be beneficial to the livestock industry and would enhance wildlife habitat. Wildlife habitat improvement would also result from development of stock and game water facilities and further development of grazing management systems which would protect critical wildlife areas.

More intensively used land, such as urban, industrial, roads, highways, and other special use areas, would have substantially improved and esthetic cover to protect them, especially during construction. While some of this protection would result from measures and practices initiated in these areas, most would occur from improved and more intensive management practices and conditions on surrounding or adjacent crop, range, and forest lands.

Further Studies

Further studies required of the coastal zone and estuaries, watersheds, river basins, and to obtain facts for planning are described in preceding portions of the text. These studies are:

(1) Coastal Zone and Estuaries

Physical, hydrologic, and biologic studies are required to obtain the range of data required for planning of the coastal zone and estuaries in Washington and Oregon. Based on the findings of these investigations, a coordinated plan for use, development, and management would be evolved and implemented.

(2) Watersheds

There are 896 watersheds which have been identified as requiring measures and practices installed cooperatively to reduce erosion and sedimentation, or conserve and improve water quality, or alleviate flood or wetness problems. Studies are required to select those watersheds where corrective measures are justified or desired.

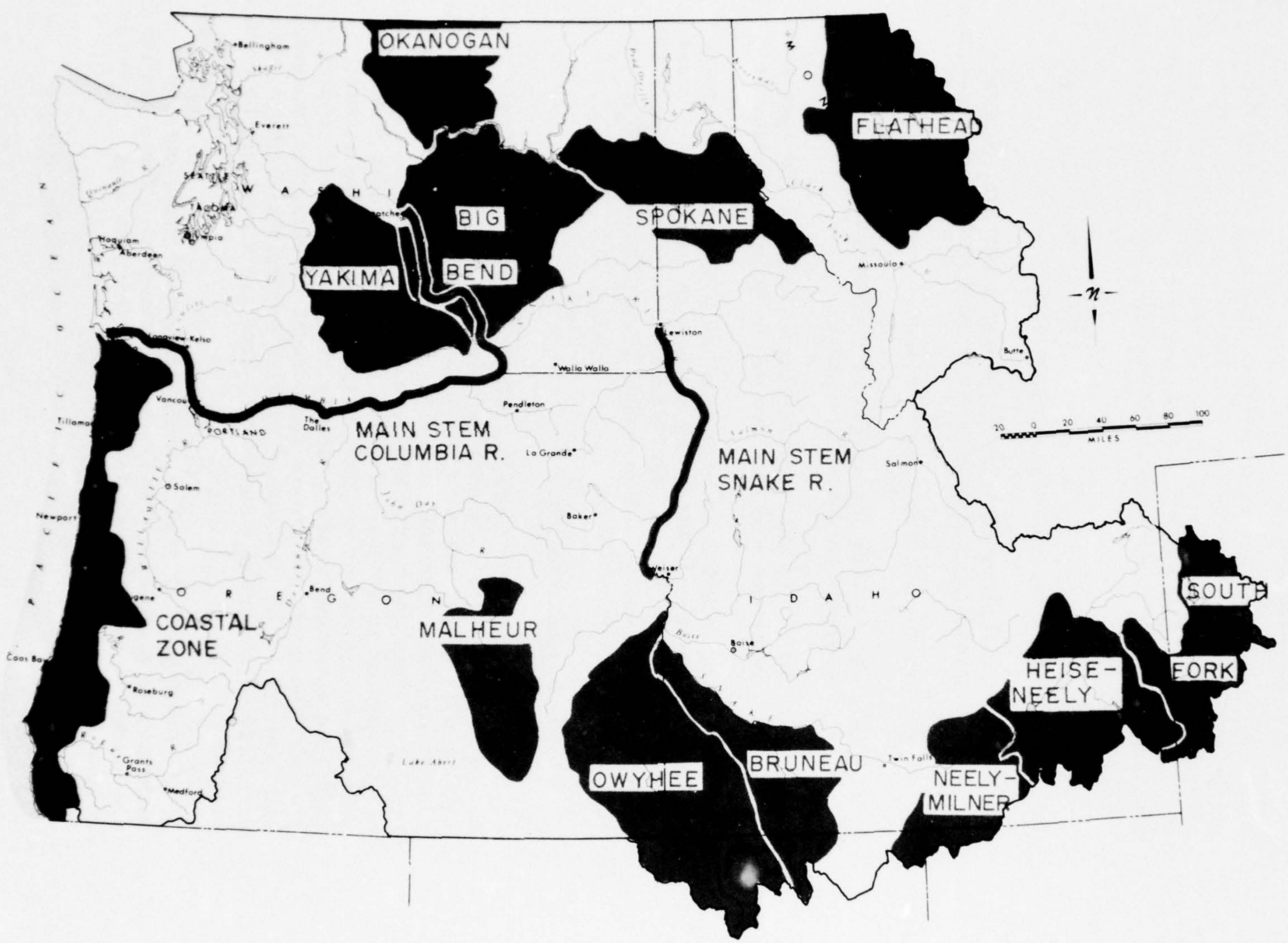


FIGURE 35. Distribution of Recommended Interdisciplinary Studies

(3) River Basins

Although the best alternatives could be selected for part of the region, there are basins or subareas where the complexity of problems and wide array of alternatives, coupled with lack of available data, precluded the selection of the best plans and programs. In those instances, interdisciplinary studies are recommended.

Figure 35 shows the 14 river basins or subareas where interdisciplinary studies are recommended:

(a) To further identify alternative methods, programs, projects, and uses of water and related land resources.

(b) To consider multipurpose features of each program.

(c) To evaluate the impact of alternative land uses and projects on the environment.

(d) To select the proper alternatives and the agency to carry out each feature of the resulting plan.

Studies relevant to more detailed planning which are now underway by State and Federal agencies were identified. These studies cover many of the river basins or subareas proposed for further studies and should be scoped to make them fully interdisciplinary.

(4) Special Studies

A wide range of special studies are needed to obtain facts for planning. One of the most important is to establish realistic minimum flow requirements in the interest of water quality, fish, recreation, and esthetics. Studies of a special nature include primitive areas and scenic roads, and a determination on whether all or part of an initial 10,000 miles of 150 streams should be included in a state or national system of recreation rivers. Extensive watershed studies, nearly 900, are required to properly evaluate the areas for future improvement of watershed management and land protection measures. Studies of regional harbors, urban waterfronts, and urban environments also are a part of the framework program.

Other special studies, from irrigation efficiency to mathematical hydrologic models, are recommended. These studies are needed to obtain facts for planning instream uses as opposed to consumptive uses of water.

Costs

General cost estimates for broad components of the regional framework plans and programs are shown on table 121. These estimates are approximations based on experience and are included for the purpose of illustrating the general magnitude of Federal and non-Federal costs for installation and for annual operation, maintenance, and replacement. The operation, maintenance, and replacement costs are based on the last year of each time increment.

The programs included in the early time period would require a total Federal investment of $6.34 billion and a non-Federal investment of $5.92 billion. The land treatment programs, including erosion and sediment control, water conservation and yield improvement, drainage, tributary stream control, and related land treatment, would comprise 35 percent of the total program costs. The next largest feature of the program would be irrigation and associated multiple-purpose storage with 31 percent. Costs for water supply and waste treatment would be 14 percent of the total investment. Costs for hydroelectric power would be $994 million in addition to the cost of completing the projects already under construction. Other programs, such as navigation, flood control, fish and wildlife, and recreation, which would comprise the balance of the program, would also be enhanced by the multiple-purpose storage associated above with irrigation. Total annual operation, maintenance, and replacement costs are estimated to be $42.3 million Federal and $187 million non-Federal.

Table 119 - Summary of Costs, Framework Plan
Columbia-North Pacific Region

Major Element	1970-1980 Investment	1970-1980 OM&R (Incr) 1/	1981-2000 Investment	1981-2000 OM&R (Incr) 1/	2001-2020 Investment	2001-2020 OM&R (Incr) 1/	1970-2020 Investment	1970-2020 OM&R 2/
				(in $1,000 units)				
Water Development & Control								
1. Electric Power	994,000	6,038	188,500	2,619	1,011,500	6,085	2,194,000	14,742
2. Navigation	184,380	14,603	579,551	32,516	213,212	21,253	977,143	68,372
3. Water Quality Control	960,317	41,221	1,255,281	29,816	1,426,970	14,183	3,642,568	85,220
4. M & I Water Supply	752,700	5,400	856,000	10,200	1,003,400	10,300	2,612,100	25,900
5. Flood Control	227,271	7,061	156,465	4,379	77,017	2,544	460,753	13,984
6. Irrigation	2,674,660	30,780	1,764,761	14,333	2,377,797	25,719	6,817,218	70,832
7. Reservoir Storage	1,196,360	5,374	1,008,670	5,077	310,033	1,178	2,515,063	11,629
Subtotal	6,989,688	110,477	6,632,228	102,406	5,596,929	77,796	19,218,845	290,679
Water and Related Land Programs								
8. Fish & Wildlife	392,719	39,275	335,439	33,544	365,752	36,573	1,093,910	109,392
9. Recreation (Water Related)	549,737	15,838	832,715	31,211	1,444,210	54,702	2,826,662	101,751
10. Related Land Programs	4,326,428	63,813	5,306,655	66,419	4,644,037	66,303	14,277,120	196,535
11. Further Studies				(not estimated)				
Subtotal	5,268,884	118,926	6,474,809	131,174	6,453,999	157,578	18,197,692	407,678
Total	12,258,572	229,403	13,107,037	233,580	12,050,928	235,374	37,416,537	698,357
Federal	6,339,682	42,338	6,117,665	51,129	5,251,989	45,257	17,709,336	138,724
Non-Federal	5,918,890	187,065	6,989,372	182,451	6,798,939	190,117	19,707,201	559,633
Associated Costs								
12. Thermal Electric Power	731,000	51,000	8,638,000	589,000	36,470,000	1,479,000	45,839,000	2,119,500
13. Power Peaking	-	-	1,725,000	16,000	7,590,000	70,600	9,315,000	86,600
Total Associated Costs	731,000	51,000	10,363,000	605,000	44,060,000	1,550,100	55,154,000	2,206,100

1/ Relates only to new investment during period.
2/ Relates to total investment, 1970-2020.

Annual investment outlays would be reduced about 50 percent in the long-range time frames with related land programs continuing to be the largest single features. Irrigation and associated multiple-purpose storage reduce relative to total costs but programs serving people--recreation and water supply and quality control--would be sharply increased. Associated costs for thermal-electric power and power peaking resources would amount to $44 billion during the final time frame, and power operation, maintenance, and replacement costs would be $1.55 billion per year by 2020.

Similar costs for each of the four areas are contained in tables 122 through 125.

Table 120 - Summary of Costs, Framework Plan, Area A

	1970-1980		1981-2000		2001-2020		1970-2020	
Major Element	Investment	OM&R (Incr) 1/	Investment	OM&R (Incr) 1/	Investment	OM&R (Incr) 1/	Investment	OM&R 2/
				(in $1,000 units)				
Water Development & Control								
1. Electric Power	420,000	1,970	705,500	3,286	50,000	475	1,175,500	5,731
2. Navigation	-	-	109,300	1,147	1,520	104	110,820	1,251
3. Water Quality Control	157,606	4,847	261,384	5,867	289,071	2,698	708,061	13,412
4. M & I Water Supply	112,800	700	126,400	1,300	141,900	1,400	381,100	3,400
5. Flood Control	40,075	281	15,355	76	5,145	29	60,575	386
6. Irrigation	1,034,090	8,053	622,688	3,973	1,347,625	11,118	3,004,403	23,144
7. Reservoir Storage	105,500	440	126,743	128	132,933	196	365,176	764
Subtotal	1,870,071	16,291	1,967,370	15,777	1,968,194	16,020	5,805,635	48,088
Water and Related Land Programs								
8. Fish & Wildlife	78,144	7,817	45,652	4,565	64,222	6,420	188,018	18,802
9. Recreation (Water Related)	31,958	1,925	85,905	5,175	153,550	9,250	271,413	16,350
10. Related Land Programs	1,497.874	12,957	1,530,605	16,662	1,299,159	18,697	4,327,638	48,316
11. Further Studies				(not estimated)				
Subtotal	1,607,976	22,699	1,662,162	26,402	1,516,931	34,367	4,787,069	83,468
Total	3,478,047	38,990	3,629,532	42,179	3,485,125	50,387	10,592,704	131,556
Federal	1,963,445	10,904	2,036,315	10,931	1,997,771	15,149	5,997,531	36,984
Non-Federal	1,514,602	28,086	1,593,217	31,248	1,487,354	35,238	4,595,173	94,572
Associated Costs								
12. Thermal Electric Power	264,000	18,000	440,000	30,000	15,400,000	85,000	16,104,000	133,000
Total Associated Costs	264,000	18,000	440,000	30,000	15,400,000	85,000	16,104,000	133,000

1/ Relates only to new investment during period.
2/ Relates to total investment, 1970-2020.

Table 121 - Summary of Costs, Framework Plan, Area B

Major Element	1970-1980 Investment	1970-1980 OM&R (Incr) 1/	1981-2000 Investment	1981-2000 OM&R (Incr) 1/	2001-2020 Investment	2001-2020 OM&R (Incr) 1/	1970-2020 Investment	1970-2020 OM&R 2/
				(in $1,000 units)				
Water Development & Control								
1. Electric Power	224,000	1,898	159,000	1,319	131,000	2,031	514,000	5,248
2. Navigation	6,680	668	29,351	539	3,092	309	39,123	1,516
3. Water Quality Control	137,513	5,176	201,907	4,565	255,255	2,257	564,675	11,998
4. M & I Water Supply	69,800	500	78,500	900	89,000	900	237,300	2,300
5. Flood Control	21,896	260	7,410	35	4,167	21	33,473	316
6. Irrigation	993,357	14,577	691,121	5,334	538,361	9,150	2,222,839	29,061
7. Reservoir Storage	239,266	1,887	192,272	1,057	-	-	431,538	2,944
Subtotal	1,692,512	24,966	1,359,561	13,749	990,875	14,668	4,042,948	53,383
Water and Related Land Programs								
8. Fish & Wildlife	54,880	5,488	66,927	6,693	50,767	5,077	172,574	17,258
9. Recreation (Water Related)	34,030	2,050	85,490	5,150	148,155	8,925	267,675	16,125
10. Related Land Programs	739,787	27,475	1,045,153	20,359	826,154	24,811	2,611,094	72,645
11. Further Studies				(not estimated)				
Subtotal	828,697	35,013	1,197,570	32,202	1,025,076	38,813	3,051,343	106,028
Total	2,521,209	59,979	2,557,131	45,951	2,015,951	53,481	7,094,291	159,411
Federal	1,528,148	9,311	1,206,257	9,051	1,158,955	10,527	3,893,360	28,889
Non-Federal	993,061	50,668	1,350,874	36,900	856,996	42,954	3,200,931	130,522
Associated Costs					(none)			

1/ Relates only to new investment during period.
2/ Relates to total investment, 1970-2020.

Table 122 - Summary of Costs, Framework Plan, Area C

Major Element	1970-1980 Investment	1970-1980 OM&R (Incr) 1/	1981-2000 Investment	1981-2000 OM&R (Incr) 1/	2001-2020 Investment	2001-2020 OM&R (Incr) 1/	1970-2020 Investment	1970-2020 OM&R 2/
				(in $1,000 units)				
Water Development & Control								
1. Electric Power	280,000	1,270	130,000	1,330	7,500	113	417,500	2,713
2. Navigation	29,200	1,235	76,900	2,030	6,400	640	112,500	3,905
3. Water Quality Control	298,098	16,879	517,294	17,966	591,049	5,504	1,406,441	40,349
4. M & I Water Supply	243,800	1,400	250,000	2,300	280,400	2,300	774,200	6,000
5. Flood Control	44,900	395	53,500	268	18,800	94	117,200	757
6. Irrigation	538,088	5,466	416,290	4,397	408,091	4,479	1,362,469	14,342
7. Reservoir Storage	656,535	2,897	472,955	3,732	163,100	972	1,292,590	7,601
Subtotal	2,090,621	29,542	1,916,929	32,023	1,475,340	14,102	5,482,900	75,667
Water and Related Land Programs								
8. Fish & Wildlife	137,209	13,721	141,739	14,739	126,950	12,695	405,898	40,590
9. Recreation (Water Related)	57,934	3,490	153,550	9,250	292,575	17,625	504,059	30,365
10. Related Land Programs	1,355,054	19,113	1,640,870	25,636	1,496,515	18,936	4,492,439	63,685
11. Further Studies				(not estimated)				
Subtotal	1,550,197	36,324	1,936,159	49,060	1,916,040	49,256	5,402,396	134,640
Total	3,640,818	65,866	3,853,098	81,083	3,391,380	63,358	10,885,296	210,307
Federal	2,053,706	14,652	1,913,766	18,091	1,389,016	12,619	5,356,488	45,362
Non-Federal	1,587,112	51,214	1,939,332	62,992	2,002,364	50,739	5,528,808	164,945
Associated Costs								
12. Thermal Electric Power	242,000	16,500	5,148,000	351,000	12,370,000	802,500	17,760,000	1,170,000
Total Associated Costs	242,000	16,500	5,148,000	351,000	12,370,000	802,500	17,760,000	1,170,000

1/ Relates only to new investment during period.
2/ Relates to total investment, 1970-2020.

Table 123 - Summary of Costs, Framework Plan, Area D

Major Element	1970-1980 Investment	1970-1980 OM&R (Incr) 1/	1981-2000 Investment	1981-2000 OM&R (Incr) 1/	2001-2020 Investment	2001-2020 OM&R (Incr) 1/	1970-2020 Investment	1970-2020 OM&R 2/
				(in $1,000 units)				
Water Development & Control								
1. Electric Power	70,000	900	17,000	150	-	-	87,000	1,050
2. Navigation	148,500	12,700	364,000	28,800	202,200	20,200	714,700	61,700
3. Water Quality Control	367,100	14,319	274,696	1,418	321,595	3,724	963,391	19,461
4. M & I Water Supply	326,300	2,800	401,100	5,700	492,100	5,700	1,219,500	14,200
5. Flood Control	120,400	6,125	80,200	4,000	48,905	2,400	249,505	12,525
6. Irrigation	109,125	2,684	34,662	629	83,720	972	227,507	4,285
7. Reservoir Storage	195,059	150	216,700	160	14,000	10	425,759	320
Subtotal	1,336,484	39,678	1,388,358	40,857	1,162,520	33,006	3,887,362	113,541
Water and Related Land Programs								
8. Fish & Wildlife	122,486	12,249	81,121	8,112	123,813	12,381	327,420	32,742
9. Recreation (Water Related)	425,815	8,373	507,770	11,636	849,930	18,902	1,783,515	38,911
10. Related Land Programs	733,713	4,268	1,090,027	3,762	1,022,209	3,859	2,845,949	11,889
11. Further Studies				(not estimated)				
Subtotal	1,282,014	24,890	1,678,918	23,510	1,995,952	35,142	4,956,884	83,542
Total	2,618,498	64,568	3,067,276	64,367	3,158,472	68,148	8,844,246	197,083
Federal	794,383	7,471	961,327	13,056	706,247	6,962	2,461,957	27,489
Non-Federal	1,824,115	57,097	2,105,949	51,311	2,452,225	61,186	6,382,289	169,594
Associated Costs								
12. Thermal Electric Power	225,000	16,500	3,050,000	208,000	8,700,000	592,000	11,9[illegible],000	816,500
Total Associated Costs	225,000	16,500	3,050,000	208,000	8,700,000	592,000	11,975,000	816,500

1/ Relates only to new investment during period.
2/ Relates to total investment, 1970-2020.

Water & Related Land Situations

Water and land requirements to meet the region's share of the Nation's food and fiber needs are small in relation to the total resource available. However, because of seasonal differences in precipitation and streamflow, and diversified instream uses, storage is often required to provide water for both instream and withdrawal purposes. There is a surplus of land suitable for intensive uses, but some land has climatic limitations or is situated some distance from the water supplies. Wildlife habitat is an important land use that is in direct competition with many developmental programs. In spite of the large land area, wildlife habitat becomes more critical with every acre lost to other uses. Recreation uses for camping, skiing, snowmobiling, etc. also often compete with wildlife.

Water

Under 1970 conditions, the total average annual surface-water discharge of the region was 310,000 cfs (224 million acre-feet). In addition, Canada contributed another 74,000 cfs (54 million acre-feet) making a total of 384,000 cfs or 278 million acre-feet annually. Approximately 240,000 cfs (175.7 million acre-feet annually) were in the Columbia River system. This is a large quantity of water, but it is not always available wherever needed because of areal distribution and the timing of runoff. For example, in the Columbia River only 185,000 (134 million acre-feet annually) of the 240,000 cfs are available 80 percent of the time and the minimum flow is only 166,000 cfs (121 million acre-feet annually) or two-thirds of the mean. In most of the other streams, the minimum year discharge is only 60 percent of the average. Also in some of the larger and most small streams, the minimum is less than 25 percent of the long-term average. This introduces critical water shortages in many areas during the low flow period which generally extends from July through the winter.

Ground water is also an important element in current and projected use. The region contains roughly 550 million acre-feet in the top 50 to 100 feet of the water-bearing strata. Gross annual recharge is estimated to be 129 million acre-feet annually. However, some of the water moves from surface to ground water two or three times in its travel so that the net annual recharge is probably on the order of 100 million acre-feet.

Total annual ground-water withdrawal is estimated to be about 4.9 million acre-feet in 1970, of which about 3.6 million acre-feet are for irrigation and 1.3 million acre-feet for municipal, industrial, and rural domestic water supply. Ground-water withdrawals are estimated to increase to 10.6 million

acre-feet by 2020, when depletions could be about 5 million acre-feet. About half of the withdrawals and depletions would be in the Snake River Basin, with the remainder distributed about evenly among the other areas.

Figure 36 illustrates projected ground-water withdrawals and depletions to 2020 for the region, the upper Columbia River Basin and the Snake River Basin.

Although the Pacific Northwest has large quantities of ground water, additional development will add little to total water supplies and, in some places, could contribute to already critical streamflow conditions. This latter condition may be especially true in the Snake River Basin of southern Idaho where the bulk of the ground-water use takes place.

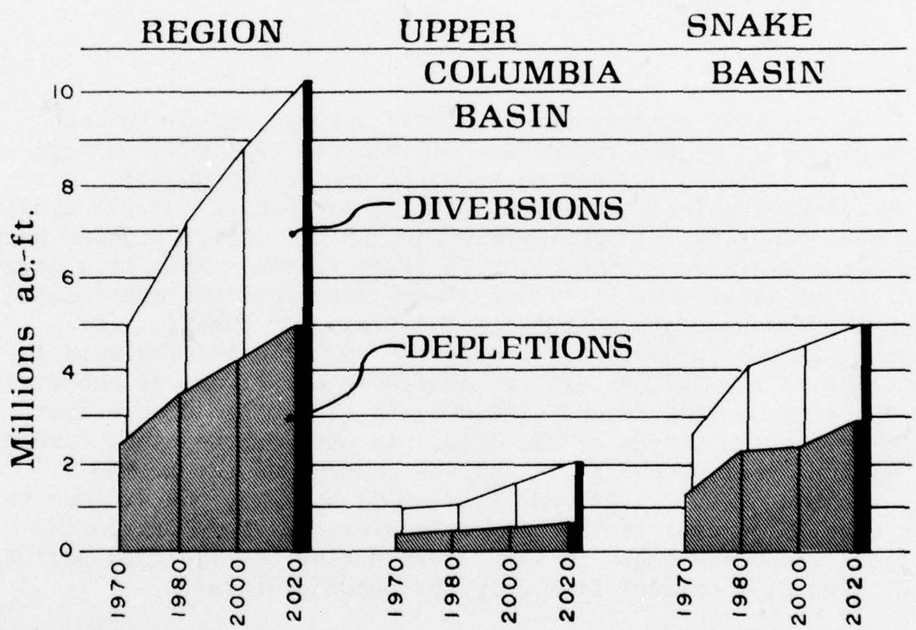


FIGURE 36. Projections of Ground-Water Use, Columbia-North Pacific Region

Because of the interrelationships, both surface and ground water are included in the following discussions of the projected water withdrawals and use.

Withdrawal of water in 1970 approximated 41.0 million acre-feet of which 33.7 million acre-feet were used to irrigate 7.5 million acres of land. Municipal, industrial, and rural-domestic water supply, fish and wildlife, thermal power, and other uses required a withdrawal of 7.3 million acre-feet. The total depletion was estimated to be 16.9 million acre-feet, 86 percent of which was from surface supplies. Figure 37 illustrates the current and projected withdrawals and depletions by major uses.

Estimates of water withdrawals were made to meet the projected population, industrial, and food and fiber needs. Withdrawals for irrigation would increase to 56.7 million acre-feet by 2020. Withdrawals for other purposes would be about 18.7 million acre-feet by 2020. Depletions by 2020 are estimated at 33.6 million acre-feet, 85 percent of which would be from surface water. Irrigation would cause 83.5 percent of these depletions. About 5.5 percent of the depletions would result from municipal, industrial, and rural-domestic water supplies, 2.6 percent from fish and wildlife, and 6.5 percent from thermal power.

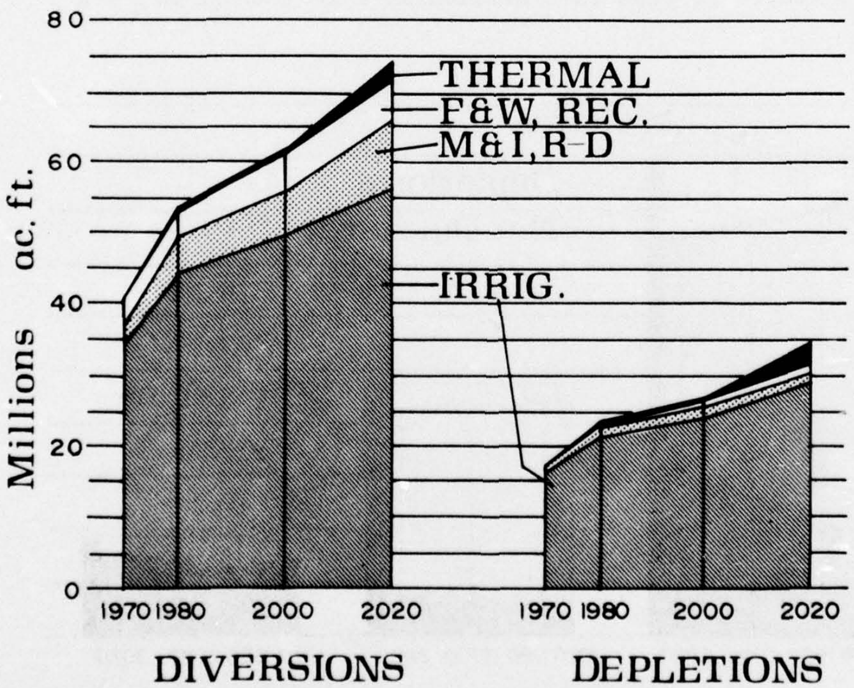


FIGURE 37. Projected Water Use, Columbia-North Pacific Region

Table 124 summarizes the water withdrawals and depletions for ground and surface water by time period. Figure 38 gives these data for the Columbia River, upper Columbia, and Snake River as compared to available flows on an average annual basis. The chart for the Snake River shows a situation where total withdrawals exceed normal streamflows. This would occur because of reuse of return flows.

The total withdrawals from the entire Columbia River system were estimated to be 37 million acre-feet in 1970 and projected to 48.6 million acre-feet in 1980, 55.1 in 2000, and 65.3 in 2020. The depletion in 2020 was estimated to be 30.3 million acre-feet. The application of this depletion to the flow available 80 percent of the time would reduce it from 134 million acre-feet to 118 million acre-feet, more than 3 million acre-feet below the minimum yearly discharge of 121 million acre-feet.

Total withdrawals from the Snake River Basin were estimated to be 21.8 million acre-feet in 1970, 26.6 million acre-feet by 1980, 28.5 million acre-feet by 2000, and 31.1 million acre-feet by 2020. In 2020, 82.5 percent of withdrawals would be from surface water. The depletion in 2020 was estimated to be 13.7 million acre-feet, an increase of 5.1 million acre-feet over 1970 conditions. Applying this depletion to the flow available 80 percent of the time would reduce it from 25.5 million acre-feet to 20 million acre-feet.

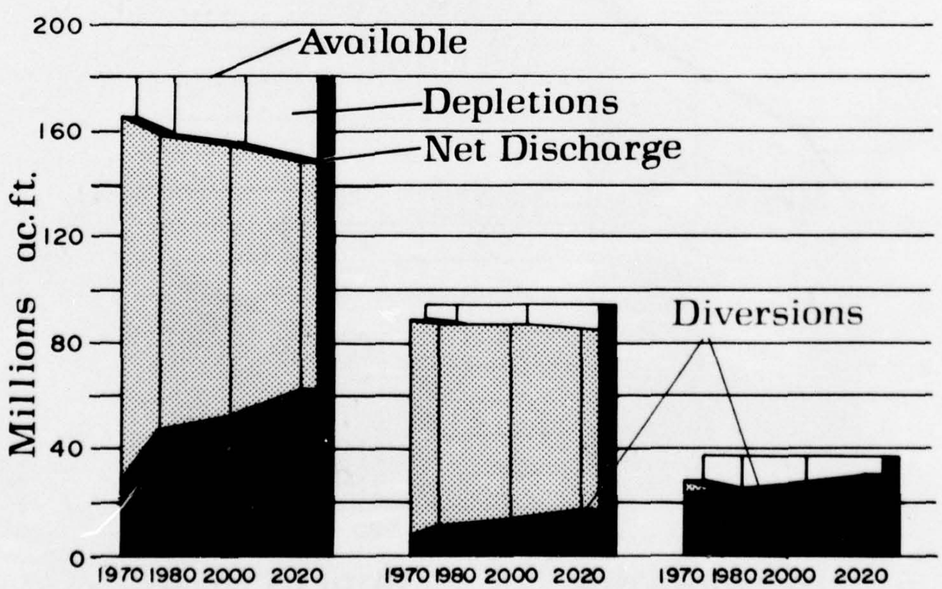


FIGURE 38. Water Supply, Withdrawals, and Depletions, Columbia-North Pacific Region

Table 124 - Summary of Water Withdrawals and Depletions
Columbia-North Pacific Region

Use	Ground				Surface				Total			
	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020
						(1,000 ac-ft)						
						Withdrawals						
Municipal	507	681	1,022	1,507	624	926	1,440	2,320	1,131	1,607	2,462	3,827
Industrial	622	787	1,104	1,454	1,520	2,017	2,978	3,958	2,142	2,804	4,082	5,412
Rural-Domestic	217	255	320	395	19	25	34	41	236	280	354	436
Irrigation	3,561	5,371	6,084	7,066	30,178	39,131	43,396	49,606	33,739	44,502	49,480	56,672
Thermal Power	0	0	0	0	824	116	747	2,143	824	116	747	2,143
Fish & Wildlife	17	76	138	167	2,921	3,653	4,372	5,858	2,938	3,729	4,510	6,025
Water Quality	0	87	44	47	0	0	0	0	0	87	44	47
Total	4,924	7,257	8,712	10,636	36,086	45,868	52,967	63,926	41,010	53,125	61,679	74,562
						Depletions						
Municipal	103	141	210	309	127	186	290	464	230	327	500	773
Industrial	103	134	190	243	259	342	514	692	362	476	704	935
Rural-Domestic	70	83	102	128	8	9	12	15	78	92	114	143
Irrigation	2,073	3,148	3,582	4,226	13,701	18,615	20,747	24,541	15,774	21,763	24,329	28,767
Thermal Power	0	0	0	0	24	116	747	2,143	24	116	747	2,143
Fish & Wildlife	10	29	53	68	376	501	617	804	386	530	670	872
Water Quality	0	0	0	0	0	0	0	0	0	0	0	0
Total	2,359	3,535	4,137	4,974	14,495	19,769	22,927	28,659	16,854	23,304	27,064	33,633

Consideration of flows on this basis leaves the impression that large quantities of water are available annually. This is not a true picture. Water is not always available wherever needed because of areal distribution and the timing of runoff. For example, the average annual flow of the Snake River at Weiser in 1970 was 15,070 cfs. By 2020, projected irrigation and other upstream developments could reduce the average annual flow at Weiser to between 9,000 and 9,600 cfs. In addition, it is estimated that 903,000 acres of presently irrigated lands are water short. Based on average flows alone, serious conflicts arise between irrigation diversions and instream needs. When considering the limited upstream storage opportunities and flows during dry periods, the conflict is even more serious. Therefore, a detailed study of the Snake River Basin is included in the framework plan to evaluate the potential for additional storage and ground-water withdrawals with full consideration for maintaining instream flows.

Instream use of water is of paramount importance to the region where it is used repeatedly for hydroelectric power production, recreation, navigation, fish, wildlife, esthetics, and water quality control. Flowing waters in the stream represent an important part of the region's natural environment. The importance of these uses to the people of the region and the Nation cannot be overemphasized.

Hydroelectric power is the dominant manmade use. Water in the Columbia River at the Canadian border passes through 11 hydroelectric plants before entering the Pacific Ocean. The regional hydroelectric generating capacity will exceed 23,000 MW when the projects under construction are completed. The total ultimate capacity of existing plants is about 34,000 MW.

The instream recreation uses involve boating, swimming, fishing, water skiing, and sightseeing. Water related recreation use is expected to increase from about 89 million recreation days to more than 511 million by 2020. Based on surface water requirements for these recreation activities, an estimated 1.9 million acres of surface water will be used by 2020. The region's streams, lakes, and estuaries have always been the habitat for many species of fish, waterfowl, fur bearing and other animals, birds, and in the case of estuaries, shellfish. Sport fishing alone represented over 21 million user days in 1965. By 2020, the sport fishing is estimated to increase to 64 million user days, three times the 1965 use. Present commercial anadromous fish landings of nearly 45 million pounds are expected to increase to 134 million pounds by 2020, much of which must be produced in area waters.

The Columbia, Willamette, and Snake Rivers carry almost 19 million tons of commerce annually. Total commerce on these rivers is projected to increase to over 33 million tons annually

by 2020. On the basis of the authorized 40-foot channel, flows of 77,000 cfs are required on the Columbia River below Vancouver for navigation. The flow requirement decreases to 58,000 cfs at the lower entrance of Bonneville lock. Commercial navigation on the Willamette River is based on a flow of 6,000 cfs below the mouth of the Santiam River. Navigation is also important on the tidal reaches of many of the streams flowing directly into the bays and ocean.

One of the most critical needs is to determine flow requirements for fish, water quality, and esthetics. The volume of streamflow is important to water quality because certain flows are required for assimilation of treated wastes and to maintain temperatures suitable for high quality fish life. Only the State of Oregon has made efforts to determine realistic values for minimum flows. There is an urgent need to determine minimum flow requirements at key points such as Milner Dam, King Hill, and Weiser on the Snake River, because the selection of a plan for the Snake River depends, to a great extent, on available flows at these points. Instream flow needs are essential to permit planning at any level. Accordingly, studies are required to establish minimum flows.

Land

The land resources are generally adequate to meet projected needs and to retain the area's environmental characteristics. The plan attempts to meet projected needs with the least detrimental effect on the environmental and nonrenewable resources. A summary of projected cover and land use acreages used in the plan is contained in table 125 by time period and use.

The only real change in the land resource, as defined in this study, is an estimated reduction in land area from 173.7 to 172.8 million acres due to the construction of reservoirs. This is a loss from the land base of .05 percent. The main problem, therefore, is limitation imposed on the resource due to soil, position, topography, and climate as affected by the changes in land use and cover to meet the requirements of the plan.

The largest use of land is for the production of food and fiber. There are almost 51.2 million acres with soils, topography, and climate suitable for cropping. Only 20.8 million acres are being cropped, and the plan calls for a modest increase of 4 percent to 21.7 million by 2020. About 42 percent of the arable land would be cropped by 2020. The major change is a shift from nonirrigated to irrigated cropland, with irrigated cropland increasing about 84 percent and dry cropland decreasing 37 percent. About 40.2 million acres are considered to be irrigable and, by 2020, 13.5 million

Table 125 - Summary of Planned Cover and Land Use, Columbia-North Pacific Region

	Area A				Area B				Area C				Area D				Total			
	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020	1970	1980	2000	2020
								(1,000 acres)												
Area Cover & Land Use																				
Rangeland	7,817	7,288	7,233	6,965	35,437	34,734	34,593	34,283	15,263	15,081	15,035	15,009	228	223	209	198	58,745	57,326	57,070	56,455
Forest Land	25,403	25,242	25,117	24,926	22,025	21,939	21,842	21,715	25,648	25,512	25,200	25,074	12,768	12,736	12,638	12,447	85,844	85,429	84,797	84,162
Commercial	(21,579)	(21,418)	(21,293)	(21,102)	(15,591)	(15,516)	(15,420)	(15,322)	(22,511)	(22,395)	(22,116)	(22,045)	(10,687)	(10,655)	(10,557)	(10,367)	(70,368)	(69,984)	(69,386)	(68,836)
Noncommercial	(3,824)	(3,824)	(3,824)	(3,824)	(6,434)	(6,423)	(6,422)	(6,393)	(3,137)	(3,117)	(3,084)	(3,029)	(2,081)	(2,081)	(2,081)	(2,080)	(15,476)	(15,445)	(15,411)	(15,326)
Cropland	5,547	5.912	5,820	5,998	8,488	9,046	9,102	9,348	5,815	5,840	5,885	5,747	954	771	657	611	20,804	21,569	21,464	21,704
Irrigated	(1,662)	(2,611)	(2,925)	(3,736)	(4,099)	(5,174)	(5,537)	(6,251)	(1,249)	(1,804)	(2,340)	(2,778)	(122)	(241)	(305)	(389)	(7,132)	(9,850)	(11,107)	(13,154)
Nonirrigated	(3,885)	(3,301)	(2,895)	(2,262)	(4,389)	(3,872)	(3,565)	(3,097)	(4,566)	(4,036)	(3,545)	(2,969)	(832)	(530)	(352)	(222)	(13,672)	(11,739)	(10,357)	(8,550)
Other Land	1,984	2,119	2,299	2,479	2,501	2,596	2,715	2,839	2,078	2,320	2,570	2,831	1,760	1,931	2,130	2,351	8,323	8,966	9,714	10,500
Urban & Industrial	(372)	(396)	(432)	(476)	(229)	(247)	(271)	(298)	(723)	(791)	(877)	(981)	(663)	(735)	(826)	(941)	(1,987)	(2,169)	(2,406)	(2,696)
Remainder	(1,612)	(1,723)	(1,867)	(2,003)	(2,272)	(2,349)	(2,444)	(2,541)	(1,355)	(1,529)	(1,693)	(1,850)	(1,097)	(1,196)	(1,304)	(1,410)	(6,336)	(6,797)	(7,308)	(7,804)
Total Land Area	40,751	40,561	40,469	40,368	68,451	68,315	68,252	68,185	48,804	48,753	48,690	48,661	15,710	15,661	15,634	15,607	173,716	173,290	173,045	172,821
Water Surfaces	769	959	1,051	1,152	517	653	716	783	379	430	493	522	244	293	320	347	1,909	2,335	2,580	2,804
Total Area	41,520	41,520	41,520	41,520	68,968	68,968	68,968	68,968	49,183	49,183	49,183	49,183	15,954	15,954	15,954	15,954	175,625	175,625	175,625	175,625
Ancillary Land Uses																				
Fish & Wildlife	38,767	38,442	38,170	37,889	65,950	65,719	65,537	65,346	46,726	46,433	46,120	45,830	13,950	13,730	13,504	13,256	165,393	164,324	163,331	162,321
Water Related Recreation Facility Development	9	16	23	41	6	12	20	36	9	27	49	91	7	21	38	72	31	76	130	240
Total Irrigated Area	1,843	2,690	3,010	3,850	4,226	5,311	5,701	6,441	1,292	1,858	2,406	2,850	142	253	317	400	7,503	10,112	11,434	13,541

acres would be irrigated under the plan, an increase of more than 80 percent in 50 years, but only one-third of the ultimate potential.

There would be an increase in other land from 8.3 to 10.5 million acres in 2020, an increase of 26 percent. This increase is represented by areas for urban, industrial, transportation, and recreation uses, and small ponds and reservoirs.

The increases in crop and other lands are expected to be met largely at the expense of the forest and rangelands. Programs to offset this areal reduction and still meet the increased food and fiber needs consist mostly of more intensive management. Projections indicate the forest area will decline from 85.8 to 84.2 million acres by 2020, primarily commercial forest land; the 58.7 million acres of range will be reduced by 2.3 million in the same period.

These shifts in land use and cover will also affect the ancillary uses. Water associated recreational land development is projected to expand 674 percent but the total land use shift would be small in comparison to the total area. Additional wilderness areas and wild, recreation, and scenic rivers are potentials that are identified and the plan calls for studies to select those most appropriate to satisfy the local, state, and national interest.

The region contains significant big game, waterfowl, and upland bird habitat. The total natural land habitat is projected to decrease almost 2 percent as a result of expanded farming, water storage, recreation, urban, and industrial uses. However, the plan provides for increased big game and bird populations per unit of land area due to intensive management measures. In areas where big game winter habitat is becoming scarce or critical, the plan points out the need to curtail competing land uses.

Alternatives

The formulation of the framework plan is premised on meeting needs derived from the March 1968 OBERS projections as modified by projections made in connection with comprehensive studies of Subregions 9 and 11. Because projected population, employment, and other economic parameters are based primarily on national projections made in 1968 (OBERS), the framework study does not reflect concepts such as zero population growth, curtailment of industrial growth, or reduced migration into the region. However, in the plan formulation process major alternatives directed toward economic efficiency, regional development, and environmental quality objectives were given equal consideration. Alternatives considered and plan elements selected to meet the

needs of the four individual areas are presented in previous portions of this appendix. In the following text, only alternatives relating to the region as a whole are discussed.

Electric Power

As of December 31, 1969, the region's electric generating capacity (nameplate) was 18,963 megawatts, and additional capacity amounting to 9,167 megawatts was under construction; over 90 percent of the existing capacity was hydroelectric. With the exception of the 800 megawatt Hanford nuclear plant and the 1,400 megawatt plant under construction at Centralia, Washington, most of the thermal capacity is old and normally used only as reserves. However, in 1970, construction started on another large thermal plant, the 1,130 megwatt nuclear Trojan plant at Rainier, Oregon. In addition, there is under active consideration 12,900 megawatts of capability, about 65 percent of which is hydroelectric. A large share of the hydro capacity currently under construction or active consideration consists of expansion of existing projects.

The projected future power requirements given in table 39 show an increase of more than 12 times between 1970 and 2020. To satisfy these needs, load resource analyses were made for two different systems as described under Regional Planning Consideration. The framework plan for electric power closely approximates the minimum hydroelectric system except that it includes appropriate power installations at projects needed to meet other functions. The alternative plan for hydroelectric development would have included potential hydroelectric projects which are highly controversial because of environmental impacts or are not economically justified under present standards.

Regardless of the alternative selected, the satisfaction of future power needs will be a continuing problem. The benefits of electric power, for communication, for industry, and for home use are recognized by most everyone and are taken for granted. Still, every proposal for another powerplant, whether it be hydroelectric or thermal, brings a deluge of objections.

The projection of power requirements to 2020 is an extension of load growth experience which may not ensue. For example, there is little doubt that environmental pressures will increase the cost of producing electric power. Accepting the social responsibility for safeguarding the environment with higher costs could influence the location of industry, thus causing material changes in industrial loads. Also, capital investments of industries sensitive to power costs may be slow pending stabilization of future power rates.

Alternate plans for electric power should include not only a mix of thermal and electric power sources but also include consideration of alternate levels of use or production. Reduction of power requirements by increased efficiency, pricing, or policies should be explored.

Navigation

With excellent ports accessible both to the Pacific Ocean and the Columbia River waterway and the excellent rail and highway networks connecting to them, transportation by water is important to the region's economy. Waterborne commerce is expanding rapidly in response to need and opportunity. The amount of growth in cargo tonnage moved over the waterways in the future depends to a large extent on how well the inland waterway haulers and deep-draft shippers meet the demand for more efficient and economical means of transshipment. In this connection, all forms of transportation have a role to play. In order for inland waterways to perform their function of moving bulk commodities, both dry and liquid, land transportation, rail, highway, and pipeline must be linked to it in an effective and efficient manner.

Because of the physical and geographical composition of waterborne commerce, major alternatives are rather limited. The foreign commerce is all ocean oriented and the only real alternatives are shifts in major ports and types of vessels. The protected and deep waters of the Puget Sound Subregion would accommodate nearly all future vessels. Because of depth limitations in the lower Columbia River system, larger size tankers drawing 45 feet or more could not enter those waters but nearly all other vessels would have free access to the Portland-Vancouver area.

Appendix X, Navigation, recognizes the potential for LASH (lighter aboard ship) and other ocean-going vessel changes. Future vessels will be more efficient and thus move larger amounts of cargo which would be reflected in the inland fleet of barges and tow boats and other modes of transportation. However, the potential changes in the ocean-going vessels would have little effect on the framework plan. In addition, the Columbia River and Subregion 11 are the only major navigation systems so no large shifts in the region's share of commerce between subregions are predicted.

However, any harbor, port, or waterfront development or redevelopment requires consideration of a range of alternatives including all feasible technological alternatives to traditional harbor deepening, such as installation of offshore transfer facilities or use of lightering vessels. The selection of the best

plan from the standpoint of all the people entails a high degree of cooperation between ports, local governments, regional planning groups, private interests, and the several Federal agencies. This planning embraces a range of activities, from creation of entirely new port or waterfront complexes to rehabilitation and conversion of existing waterfront lands and facilities.

In 1975, a barge channel will extend along the Columbia River from the head of deep water navigation at Vancouver, to Lewiston on the Snake River in the heart of the region, 465 miles from the Pacific Ocean. The inland system, primarily the Columbia, lower Snake, and Willamette Rivers, is a significant asset to the economy. Inadequacies in two existing locks impose an economic limit on the quantity of future cargo movement. Similarly, if the alternatives of extending navigation on the Columbia River to Wenatchee and on the Willamette to Albany were not followed, more costly modes of transportation for certain bulk commerce would be an economic restraint, limiting the competitive advantages of the region. In potential structural developments of locks and channels, the major alternative is limited to either having or not having such a program. If it is the latter choice, then alternative modes of transportation must absorb any increased movement of commerce. The framework plan and programs include additional interdisciplinary studies to evaluate these alternatives.

Irrigation

Although some 7.5 million acres are now being irrigated, the region still has some 33 million acres of dry land suitable for irrigation. Approximately 43 percent of this potentially irrigable land is class 1 or 2, capable of producing high yields of all climatically adapted crops.

Based on the region's allocated share of projected national food and fiber needs, and taking into account expected yield improvement from both dry and irrigated lands, the required additional new irrigation was estimated to total 2.6 million acres by 1980, 3.9 million acres by 2000, and 6 million acres by 2020. In addition, the water supply for all currently irrigated, water-short lands would need to be increased by 2.2 million acre-feet. The total increase for both new and supplemental irrigation water amounts to 23.6 million acre-feet, resulting in increased depletions of 13.4 million acre-feet over the 1970 level.

Two factors make evident the extremely wide range of alternatives for locating new irrigation: (1) 33 million acres of suitable land from which only 6 million acres need to be selected; (2) an annual runoff of 278 million acre-feet but projected new depletions of only 13.4 million acre-feet.

Most of the irrigated lands are adjacent to major rivers. Because of multiple instream uses, withdrawal of water for irrigation now and in the future can, and does, have major impacts on the operation of the river for other purposes. At some locations, such as the upper Snake River, decisions on the required instream flow will control the extent of irrigation. Irrigation can be a significant factor in the operation of the Columbia River system, particularly during critical low-water years. Thus the location of new irrigation acreage could have a major effect on environmental quality and the general economy through additional costs or reduction in power output through depletions.

To assist in framework plan formulation, the regional irrigated acreage projections by time periods were distributed among the subregions by the Irrigation Committee as described in Appendix IX. In doing this, the irrigated crop distribution was used along with yield estimates so that the sum of all subregional production equaled the regional needs. These subregional adjusted estimates of crop production by major crop category are reported in the subregional portions of the Irrigation Appendix.

The sequential order of future irrigation development to meet the growing food and fiber needs could follow a multitude of alternative patterns in addition to the one selected for framework planning purposes. For example, the acreage could be developed in Areas A and C with less environmental effect than the major development in Area B, the Snake River Basin. The present trend toward irrigation development using private or non-Federal capital financed through loans or bonds indicates that feasibility in the financial market place is a prime consideration. A detailed economic study beyond the scope of this study would be helpful to the investor and aid in achieving a reasonable rate of irrigation development.

Table 126 - Planned Distribution of Irrigation Acreage
Columbia-North Pacific Region

Area	Existing 1970		Incremental 1970-1980		Incremental 1981-2000		Incremental 2001-2020		Total 1970-1980	
	(1,000 ac)	(Percent)	(1,000 ac)	(Percent)	(1,000 ac)	(Percent)	(1,000 ac)	(Percent)	(1,000 ac)	(Percent)
A	1,843	25	847	33	320	25	840	40	2,007	33
B	4,226	56	1,085	42	390	30	740	35	2,215	42
C	1,292	17	566	21	548	40	444	21	1,558	21
D	142	2	111	4	64	5	83	4	258	4
Region	7,503	100	2,609	100	1,322	100	2,017	100	6,038	100

Flood Control

Average annual flood damages of $34 million occur on 1.6 million acres of flood plains along major streams and tributaries. These damages are projected to increase to about $46 million in 1980, $76 million in 2000, and $135 million in 2020. These projections assume that future land use will closely follow existing patterns and that flood damages will be proportional to total development in the flood plains.

In addition, 2.3 million acres are flooded by minor tributaries and onfarm flows causing damages estimated at nearly $36 million annually. These damages are projected to increase to $84 million by 2020.

The framework plan for major streams is a mix of nonstructural and structural measures.

Under nonstructural elements, the plan proposes that local governmental agencies adopt flood plain regulations where appropriate to control future development in flood-prone areas. Such regulations are needed in 120 of the 127 counties in the region. Flood plain information studies, which have been completed for 33 localities, are needed for all other areas where flood plain regulations would be prescribed. Flood proofing is called for to protect existing development where flood control works are not warranted or desirable at this time. Continuation and acceleration of existing Federal-State programs of flood forecasting and flood fighting are assumed.

Structural measures consisting of levees and channel improvement, single-purpose storage, and storage in multiple-purpose reservoirs were developed on the basis of judgment and preliminary estimates, recognizing that further analysis is needed to establish economic justification and order of priority.

The mix between nonstructural and structural alternatives presents a wide range of alternatives. The choice will depend on: population and economic activities; the feasibility of specific flood control measures; the possibility of building multiple-purpose reservoirs with flood control as a function; and the sociological and environmental desires of the people, i.e., retention of streams in a "free-flowing" condition.

Other Functions

Alternatives are not discussed for the functions of water quality control, municipal and industrial water supply, preservation and enhancement of natural environment, fish and wildlife, outdoor recreation, and related land programs; because the plans are sufficiently general to encompass a range of alternatives.

IMPLEMENTATION OF FRAMEWORK PLANS AND PROGRAMS

IMPLEMENTATION OF FRAMEWORK PLANS AND PROGRAMS

This study provides a flexible framework of plans and programs as a first step in a sequence of comprehensive planning efforts. From it evolves the identification of the need for more detailed studies or the identification of needed implementation studies. The end product of the study is a framework which provides a direction towards more detailed studies by giving the planner broad scale analyses of water and related land resources, the probable nature, extent of problems, cost, and timing of possible measures for their solutions. This direction will provide local, State, and Federal interests with guide for best management, use, development, and preservation of the water and related land resources of the Northwest as well as supplying a basis for accomplishing further planning where it is urgently needed, thus improving effectiveness.

These framework plans and programs form a basis for the comprehensive joint plan for Federal, State, interstate, local, and nongovernmental development of water and related land resources being prepared by the Pacific Northwest River Basins Commission pursuant to Title II, section 201(b) (2) of Public Law 89-80, the Water Resources Planning Act. These further studies will update the framework investigation, be an input to plans of individual states, and become a part of the Western U. S. Water Plan now under study by the Bureau of Reclamation, Department of the Interior, in accordance with section 201 of Public Law 90-537, 90th Congress, 2nd Session, Colorado River Basin Act. An important facet of this effort will be meetings to allow public examination of planning in a preliminary stage. Each planning step will be subjected to public review and changed as required. The alternative plan selected should be one that has been reviewed and accepted by the public and has their support.

The legislative charge to the Pacific Northwest River Basins Commission under the public law referred to above, specifies that the Commission shall prepare and keep up to date, to the extent practicable, a comprehensive, coordinated, joint plan. Accordingly, there is an adequate continuing process for maintaining the plans and programs developed by this study as a viable framework for planning and managing the region's water and related land resources.

Some specific measures required for implementation are:

1. Acceleration of Ongoing Programs. Although most of the planned early action work is a continuation of current programs, much of the program must be increased to the extent that some functional needs exceed all that has been accomplished to date. Examples are studies of rivers for recreation and fish purposes,

watershed protection and land measures, and of the coastal zone with its several estuaries. Most of these types of studies have either not been undertaken or were inadequate in the past; consequently, there is a large unmet need currently facing the region. If such studies are not undertaken in the next few years, the resultant delays in the early action study program will be reflected by increased programs in later time periods.

2. Studies. Prior to actual implementation of a project or program a Federal or State agency would complete specific authorization studies.

3. Legislative Changes. Some legislative additions and changes may be required in both Federal and State areas. This aspect is discussed in subsequent sections.

4. Level of Accomplishment. The average annual level of funding needed in each time period to fulfill the region's projected water and related land resource needs is shown on table 127.

Table 127 Federal and Non-Federal Program Costs

	1970-1980	1980-2000	2000-2020
	(in millions of dollars)		
Federal			
Total Investment	6,340	6,118	5,252
Annual Investment 1/	634	306	262
Annual Operations, Maintenance and Replacement	42	51	45
Non-Federal			
Total Investment	5,919	6,989	6,799
Annual Investment 1/	592	349	340
Annual Operations, Maintenance and Replacement	187	182	190

1/ Total investment averaged over time period.

During the 5 years of 1965 through 1969, Federal investment in water and related land resources has averaged $268 million annually. Federal expenditures at more than twice that rate would be required to meet the fund requirements of the early time period. In the later periods, this rate would decrease to near that of the past. Although no estimate was made of past non-Federal expenditures, it is reasonable to expect that similar pattern of increase would be required. Figure 39 illustrates the approximate percentage of costs for main items of the early action program, 1970 through 1980, and for the total through 2020.

The framework plans and programs meet a need based on projections of possible future conditions derived primarily on a nationwide basis. As previously stated, these projections were not taken as goals or objectives or used as an assumption that past trends will continue in the future but were used as a baseline or level of reference for further resource planning, protection, or development. The use of these baseline projections yielded an excessively large early action program for the 1970-1980 time period requiring expenditures of $6.34 billion in Federal funds and $5.92 billion in non-Federal funds, a program which is unlikely to be totally implemented because of time and budgetary constraints.

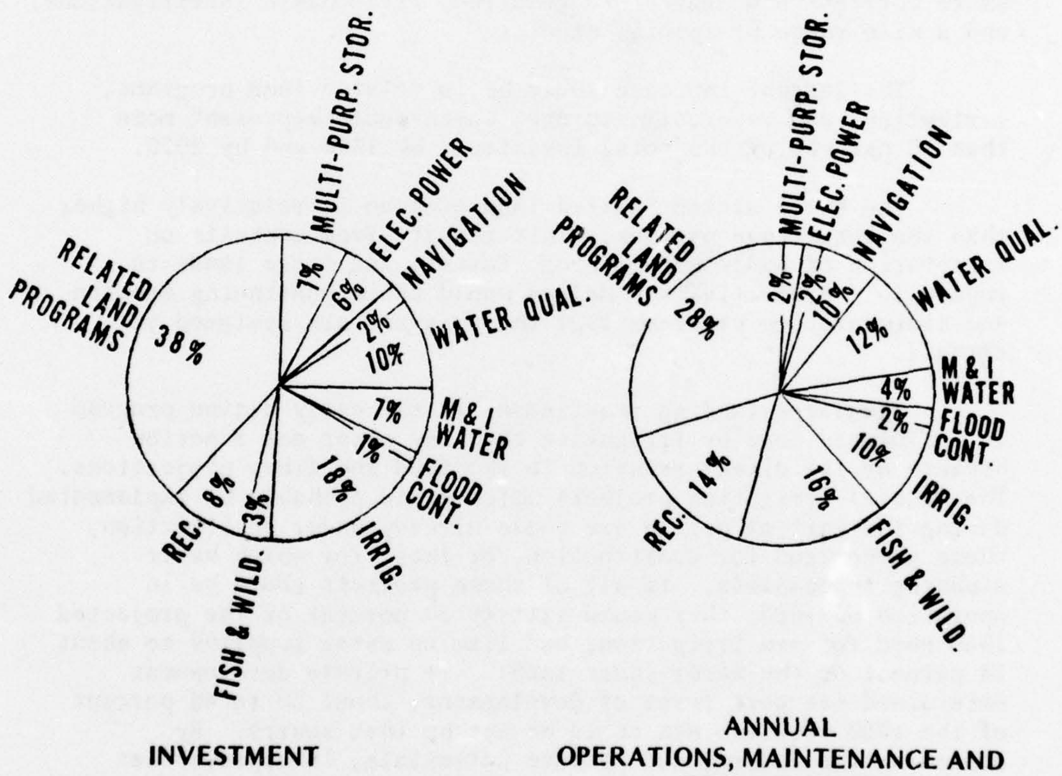


FIGURE 39. Total Investment and Annual OM&R Costs, Columbia-North Pacific Region

Further studies are required to realign the early action program to place the less important items in a later time period. For the most part, these adjustments will be made in the comprehensive joint plan being prepared by the Pacific Northwest River Basins Commission. These future studies would update the framework plans and programs and include the requisite public involvement to insure that the views of the public are fully incorporated into the plans and programs.

The large program of additional studies included in the framework plan also will assist in adjusting the time sequence of the framework plan. These studies include planning of the coastal zone and estuaries, evaluation, and selection of watersheds where corrective measures are required, river basin investigations, and a wide range of special studies.

The largest increase would be in related land programs, irrigation, and reservoir storage, which would represent more than 60 percent of the total investment by 1980 and by 2020.

The early action related land program is relatively higher than the long-range program. This results from emphasis on restoration of badly eroded crop, forest, and range lands to regain full productivity. Delays would cause continuing erosion and sedimentation problems that the programs are designed to curtail.

The large funding requirement in the early action program is influenced more by irrigation than any other one function because of its direct relation to the food and fiber projections. The Federal irrigation projects which could probably be implemented during the initial period are those already under construction, those authorized for construction, or those for which basic planning is complete. If all of those projects could be in operation by 1980, they would satisfy 30 percent of the projected 1980 need for new irrigation, and firm up water supplies to about 14 percent of the water-short lands. If private development maintained its past level of development, about 30 to 40 percent of the 1980 requirements could be met by that source. By combining the Federal and private potentials, it appears that about 60 to 70 percent of the early action irrigation program is all that could be realistically anticipated and even this would require an acceleration of Federal programs.

Reservoir storage is largely associated with Federal irrigation so their priorities would be determined by projects they are designed to serve.

For the most part, the other elements of the early action phase of the framework plan represent a level of achievement

which should be approached if at all possible. Electric power is sized to meet the load growth of the region. Water quality and municipal and industrial water supply programs are essential to the well-being of people. The relatively small navigation and flood control elements are considered to be a minimum. The level of the water related recreation plan should be expanded. Fish and wildlife measures are essential to retain this resource and to enhance it where possible.

Institutional and Legislative Considerations

Existing laws and authorities governing Federal and State agencies' activities are contained in Appendix III, Legal and Administrative Background. Institutional and legislative considerations required to implement framework plans and programs are described in the following text.

State Considerations

(1) Passage of land use and surface water zoning laws, with provision for state action if local governments do not implement adequate controls. Special attention is needed to the use and protection of riverbanks and streambeds, marine waters and shorelands; and to flood plain zoning, industrial and urban development, land drainage, agricultural lands, public access, open space and greenbelts; and requirements for urban renewal projects.

(2) Passage of legislation to improve participation in comprehensive planning at the local level.

(3) Establishment of procedural arrangements to finance state and local participation in investigations associated with program and project implementation studies. Consideration should be given credit assistance, financial assistance, and grants-in-aid to many small improvement districts and small municipalities and counties to enable sponsorship of the installation and maintenance of improvements. The state should provide this assistance including objective consultation and supervision, thus providing a needed degree of stability. Principal areas where help is needed include securing rights of way, coordinating works of development, and adding features to small, single-purpose developments that benefit the general public.

(4) Adopt a more up-to-date approach to State water law with respect to definition and recognition of beneficial uses including instream, that would ultimately permit establishment of realistic minimum and optimum flows. This should include a review of current water rights.

(5) Establish thermal plant siting entities to control and satisfy the projected tremendous increase in electric power demands, and the consequent need for development of thermal generating plants.

Federal Considerations

(1) Provide technical assistance, training, research and development, and grants to state and local government for public water supply.

(2) Modify statutes relative to the location and clearance of bridges and causeways in the navigable waters of the United States, contained in Title 33, U. S. Code, to clarify the Rivers and Harbors Act regarding responsibility for and funding of necessary alterations of bridges and causeways in the way of proposed waterway modifications.

(3) Expand the present authority of the Secretary of Agriculture under Section 216 of the Flood Control Act of 1950 so that following a natural disaster, emergency programs to rehabilitate the resource could begin in a more timely manner with the assurance that sufficient funds are available.

(4) Provide basic authority to manage the public lands and to repeal many obsolete disposal laws. The Department of the Interior has asked Congress for a modern charter for the public lands administered by the Bureau of Land Management. It includes principles of multiple use, sustained yield, and environmental protection; requirements for cooperative land use planning; and comprehensive exchange and sale authority. This proposal has been introduced as H.R. 10049 and S. 2401.

(5) Change legislation and policy governing Indian trust or restricted lands to facilitate and permit inclusion in, and assessment for operation and maintenance, betterment, and construction by any diking, drainage, flood control, flood control zone, irrigation or other improved district that may be formed.

(6) Passage of legislation to amend existing statutes governing Federal participation in recreational activities; to establish funding and administrative authority relative to beautification, conveyance of Federal surplus lands for recreation purposes, water and sewage treatment facilities, other water quality control measures, and to coordinate with other Federal, State, and local outdoor recreation plan needs, and capitol improvement programs.

(7) Passage of legislation to further fish and wildlife conservation and enhancement where statutes for the conservation and enhancement of fish and wildlife are not already in force. This would include:

(a) Provide zoning for open space, greenbelt, and fish and wildlife, and include retention of Federal lands in public ownership.

(b) Recognize the states' authority to manage resident fish and wildlife. Broader based financial support for state fish and game programs should be provided.

(c) Provide fish and wildlife habitat retention on Federal water development projects and on other Federal project lands when at all compatible. This would reduce losses to food, cover, and living areas essential to these resources.

(d) Require that a share of project lands in newly developed agricultural areas be retained in public ownership; these lands to be dedicated to wildlife habitat and to public use for hunting or other recreational activities.

(e) Provide legislation for acquisition of public streambank access downstream from water development projects.

(f) Require replacement in kind, when possible, of publicly owned fish and wildlife resources and habitat similar to the current policy of replacing publicly and privately owned utilities, townsites, and other features or structures.

Additional Studies

The nature and extent of required further studies are discussed individually in the corresponding sections of Area Plans and under Regional Framework Plans and Programs. Those discussions include a summary of current studies underway, mostly by Federal agencies, and the general scope and adequacy of coverage, as pertain to the problems and projected study requirements.

Table 114, Composition of Framework Plans and Programs, lists these studies by general categories. The following describes each of these study categories.

Coastal Zone and Estuaries

The coastal zone and each estuary need the development of a coordinated plan to insure that these resources continue to

perform their natural function in maintaining ecological balance and yet provide esthetic, recreational, and economic benefits. Basic to this planning are physical investigations and hydrologic and biological studies. The plan would integrate institutions, agencies, managerial techniques, engineering expertise into a program which is flexible enough to meet changing conditions and is backed by legislation to permit full implementation. The states of Oregon and Washington are moving toward achieving the requisite planning and control by legislation enacted in 1971, as previously described.

Watersheds

The watersheds listed below have been identified as requiring measures and practices to reduce erosion and sedimentation, conserve and improve water quality, or alleviate flood damages and wetness problems. One or more of these problems in the identified watersheds requires solution through a combination of management practices, land treatment, and structural measures on a cooperative basis.

State	Watersheds Identified
Idaho	200
Montana	61
Oregon	216
Washington	407
Wyoming	9
Nevada	3
Total	896

The inventory data for these watersheds must be refined and evaluated to select those which are justified and locally desired to meet needs.

River Basins

Interdisciplinary studies of 14 river basins or subareas are a part of the framework plans and programs. These interdisciplinary studies will be accomplished as a part of the Pacific Northwest River Basins Commission comprehensive joint plan of the Pacific Northwest. This study will begin in fiscal year 1972 pursuant to authority granted in Public Law 89-80, section 201(b)(2) and will be conducted in accordance with a "plan of study for preparing the Comprehensive Joint Plan of the Pacific Northwest--December 1971," approved by the Commission on December 1971. The output of the comprehensive study is intended to become a part of the Western U.S. Water Plan now under preparation by the

of the Interior. The time schedule calls for printing and distribution of the report by the Commission in the Fiscal Year 1977.

Special Studies

The many special studies required to obtain facts for planning would be made by the agency having the paramount interest, responsibility, or expertise. Some of these investigations would be required to obtain data for river basin studies. Others would be source of information for state, local, or individual agency programs.

The determination of minimum flows and flood plain information studies appear to be the most significant and consequently have a high priority. In some areas, planning cannot proceed until minimum instream flows have been agreed upon. Flood information studies are the key to managing flood plains by providing essential data on high flows.

The determination of water requirements for all Indian Reservations is required to obtain input to basin and state studies.

Studies of irrigation efficiency and mathematical hydrologic models are needed to obtain facts for planning instream uses as opposed to consumptive uses of water, particularly in Subregions 4 and 5 in southern Idaho. In this area, water is critical and the Snake River Basin contains a complex hydrologic system.

COMPARISON WITH OTHER PROJECTIONS

The economic projections used in the Columbia-North Pacific Study (C-NP) were derived from a national-interregional projections program (OBERS) of the U. S. Water Resources Council dated March 1968. Projections for the comprehensive Type 2 studies of Puget Sound & Adjacent Waters and the Willamette Basin substituted for OBERS projections for Subregions 9 and 11. Type 2 projections each utilize different assumptions and methodologies from OBERS for the same geographic areas. A detailed comparison of these economic projections is made in the Addendum to Appendix VI, Economic Base & Projections. Appendix C of the comprehensive study of Willamette River Basin and Appendix XV of the study of Puget Sound & Adjacent Waters also contain comparison of their projections with those made by (OBERS) which demonstrate the effect on their plans and programs.

Table 128 compares the projections used in C-NP with the June 1969 OBERS for population and personal income by the region

Table 128 - Comparison of Projections
Columbia-North Pacific Region

Sub-region	Time Period	Population C-NP	Population OBERS June 1969	Population % Change from C-NP	Total Personal Income 1/ C-NP	Total Personal Income 1/ OBERS June 1969	Total Personal Income 1/ % Change from C-NP
1	1980	699,100	649,900	-7.1	2,759,321	2,522,422	-8.6
	2000	897,050	842,000	-6.1	6,112,972	5,699,859	-7.3
	2020	1,140,360	1,086,200	-4.8	13,241,159	12,558,861	-5.1
2	1980	253,040	231,900	-8.4	1,040,513	920,941	-11.5
	2000	334,020	300,300	-10.2	2,391,910	2,113,269	-11.7
	2020	431,270	384,600	-10.8	5,352,504	4,772,985	-10.3
3	1980	280,730	268,900	-4.2	1,108,791	1,060,109	-4.4
	2000	355,200	338,500	-4.7	2,437,816	2,406,436	-1.3
	2020	443,730	425,600	-4.1	5,322,167	5,310,193	-0.2
4	1980	350,870	353,900	+0.9	1,216,921	1,264,918	+3.9
	2000	450,540	458,100	+1.7	2,707,857	2,952,454	+9.0
	2020	576,000	590,600	+2.5	6,057,552	6,780,175	+11.9
5	1980	328,690	339,100	+3.1	1,263,503	1,257,358	-0.5
	2000	430,400	450,200	+4.6	2,912,517	2,887,628	-0.9
	2020	553,480	586,000	+5.9	6,559,798	6,516,933	-0.7
6	1980	193,460	188,200	-2.7	729,348	661,910	-9.3
	2000	234,640	228,000	-2.8	1,555,513	1,473,547	-5.3
	2020	274,320	276,600	+0.8	3,263,627	3,216,320	-1.5
7	1980	251,430	242,900	-3.4	1,039,347	992,753	-4.4
	2000	321,870	301,300	-6.4	2,326,301	2,135,981	-8.2
	2020	404,370	366,600	-9.4	5,065,945	4,482,260	-11.5
8	1980	277,910	265,438	-4.5	1,114,890	1,039,312	-6.8
	2000	349,370	330,038	-5.6	2,453,383	2,275,515	-7.2
	2020	441,320	404,592	-8.3	5,422,555	4,757,442	-12.3
9	1980	1,767,500	1,500,868	-15.1	6,478,000	6,244,840	-3.6
	2000	2,422,000	2,006,762	-17.1	13,720,000	14,384,389	+4.8
	2020	3,591,000	2,587,808	-27.9	31,240,000	31,787,760	+1.8
10	1980	465,480	474,000	+1.8	1,652,375	1,741,234	+5.4
	2000	575,420	580,400	+0.9	3,600,986	3,730,199	+3.6
	2020	708,880	709,200	+0.1	7,794,152	8,141,054	+4.5
11	1980	2,726,900	2,455,800	-9.9	-	10,921,125	-
	2000	4,300,500	3,352,600	-22.0	-	24,982,718	-
	2020	6,809,400	4,352,100	-36.0	-	55,958,397	-
12	1980	16,250	15,700	-3.4	68,949	65,883	-4.5
	2000	18,670	18,100	-3.1	139,416	129,421	-7.2
	2020	21,320	20,200	-5.3	274,554	250,491	-8.8
Region	1980	7,611,360	6,988,813	-8.2	18,471,958 1/	17,771,680 1/	-3.8
	2000	10,689,680	9,210,083	-13.9	40,358,671 1/	40,188,698 1/	-0.4
	2020	15,395,450	11,789,880	-23.5	89,594,013 1/	88,744,474 1/	-0.9

1/ Exclusive of Subregion 11 where personal income data were not available.

and subregions for each of the three time periods. Personal income was not derived for Subregion 11 as gross regional product was developed. Both indices generally follow the same growth pattern. The use of the June 1969 OBERS projections would decrease population forecasts 24 percent by 2020 with almost all of the change resulting from differences in Subregions 9 and 11.

The changes made by the June 1969 OBERS projections were in population, employment, and income. As the projections for food and fiber were not altered, these changes would have little effect on irrigation, land measures, watershed protection, or any phase of plan element based on food and fiber. As irrigation accounts for most of the water depletions, the water situation resulting from the framework plans and programs would not be altered significantly by the 1969 OBERS projections.

Water quality control, municipal and industrial water supply, fish and wildlife, and outdoor recreation are mainly related to population and to industries having similar growth trends. These components of the framework would be reduced 8 percent by 1980, 14 percent by 2000, and 24 percent by 2020.

Electric power is projected on the basis of population and on the assumptions of continued industrial growth and power costs lower than national average. The effect of June 1969 OBERS is shown in table 129.

Table 129 - Comparison of Projected Electric Power Requirements
Columbia-North Pacific Region

Year	Energy (millions kwh)		Capacity (mw)	
	C-NP	1969 OBERS	C-NP	1969 OBERS
1980	193,200	193,200	34,400	34,400
2000	512,000	462,800	91,300	81,615
2020	1,286,000	1,032,000	229,400	178,960

Estimates of waterborne commerce considered production and consumption of commodities, historical trends, locational factors of origin, and destination of commodity movements which would affect diversion of traffic between transportation modes and the location of markets and sources of raw materials. A major portion of this traffic is related to food and fiber requirements or to national or international trends of supply, demand, and transportation preferences. Consequently, the use of the June 1969 OBERS would have little effect on the navigation features in the framework plans and programs.

Future municipal, industrial, and related flood damages were projected at the growth rates for total personal income and other economic growth parameters. Future agricultural damages were projected on the basis of anticipated crop yields. Allowances were made for changes in land use where such could be foreseen. Thus projections of future flood damages, the principal measure of need for flood control works, were not materially affected by use of the 1969 OBERS projections. Further, much of the flood control program was scheduled prior to 2000 when differences among the projections were small.

GLOSSARY

ACTIVITY OCCASION - Participation by an individual in any one recreation activity during any part of a 24-hour period.

BOD (BIOCHEMICAL OXYGEN DEMAND) - The quantity of oxygen utilized in the biochemical oxidation of organic matter in a specified time and at a specified temperature. It is not related to the oxygen requirements in chemical combustion, but is determined entirely by the availability of the material as a biological food and by the amount of oxygen utilized by the micro-organisms during oxidation.

CAPACITY, NAMEPLATE - The nominal rated electric power capacity of a generating unit or other similar apparatus. The term gives an indication of the approximate generating capability of the unit, but in many cases the unit is capable of generating on a continuous basis substantially more than the nameplate capacity (Installed Capacity).

CAPACITY, PEAKING - Same as Peaking Electric Power Capability.

COLIFORM BACTERIA - A species of genus escherichia coli bacteria, normal inhabitant of the intestine of man and all vertebrates. Used as an index of possible pathogenic organisms.

CRITICAL WATER YEAR - a term sometimes used interchangeably with Critical Period when the critical period falls within one operating year.

CROPLAND - Land regularly used for production of crops, except forest land and rangeland. Permanent pasture is included.

CROPLAND, IRRIGATED - Land to which water is usually applied by controlled artificial means, about 97 percent of total irrigated area.

DEPLETION (WATER) - That portion of water supply that is consumptively used.

DO (DISSOLVED OXYGEN) - The oxygen dissolved in a stream, sewage effluent or other water, usually expressed in milligrams per liter or percent of saturation.

ECOSYSTEM - An interacting system of one to many living organisms and their nonliving environment.

EVAPOTRANSPIRATION - The combined losses of evaporation of water and transpiration by plants. Evapotranspiration is often limited by the quantity of water available. A commonly used

term is potential evapotranspiration which is the maximum amount of moisture that, if continuously available, would be removed from the soil under existing conditions of humidity, wind movement, and temperature.

EFFLUENT - Sewage, water, or other liquid which is partially or completely treated or in its natural state, as the case may be, flowing out of a reservoir, basin, or treatment plant or part thereof.

EUTROPHICATION - The process of production of greater amounts of organic matter in a body of water than can be consumed through existing biologic oxidization processes. This condition may be caused by natural or artificial fertilization in conjunction with other growth factors.

FLOOD PLAIN MANAGEMENT - Comprehensive flood damage prevention program which requires integration of all alternative measures (structural and nonstructural) in investigation of flood problems and planning for wise use of the flood plain.

FLOOD PLAIN REGULATION - A general term applied to the full range of codes, ordinances, and other regulations relating to the use of land, water, and construction within a channel or flood plain area.

FLOOD PROOFING - A combination of structural changes and adjustments to properties subject to flooding primarily for the reduction of flood damages.

FOREST LAND - Land which is at least 10 percent stocked by trees of any size and land from which the trees have been removed to less than 10 percent stocking, but which has not been developed for other use.

FOSSIL FUELS - Coal, oil, natural gas, and other fuels originating from fossilized geologic deposits and depending on oxidation for release of energy.

GIGAWATT (GW) - One million kilowatts.

IRRIGATED AREA - A composite of cropland harvested and pasture, nonharvested cropland and other nonproductive and nonagricultural lands receiving an irrigation water supply.

LAND AREA - The solid portion of the earth's surface including bodies of water less than 40 acres and streams of less than 1/8 mile wide.

LAND CAPABILITY CLASS - A group of capability subclasses and units that have the same relative degree of hazards or limitations. The risks of soil damage or limitation in use become progressively greater from Class I to Class VIII.

LAND TREATMENT MEASURES - The application of vegetative measures, tillage practices, structural installations and land management, individually or in selected combinations, according to land needs and use, to alter runoff, reduce erosion and sediment, increase fertility, and improve drainage and irrigation application.

LAND USE - Primary cover or occupier of a tract of land grouped into classes with similar characteristics, i.e., cropland, rangeland, forest land, or other.

LEVEL A FRAMEWORK STUDIES AND ASSESSMENTS - Framework studies and assessments are merged into the first and broadest level of planning. They are the evaluation or appraisal on a broad basis of the needs and desires of people for the conservation, development, and utilization of water and related land resources, and will identify regions (hydrologic, political, economic, etc.) with complex problems which require more detailed investigations and analyses, and may recommend specific implementation plans and programs in areas not requiring further study. They will consider Federal, State, and local means and will be multiobjective in nature. These studies will not involve basic data collection, cost estimating, or detailed plan formulation.

LEVEL B REGIONAL OR RIVER BASIN PLANS - A regional (political, economic, etc.) or river basin plan (hydrologic region) is a preliminary or reconnaissance level water and related land plan for a selected area. These are prepared to resolve complex long-range problems identified by framework studies and the National Assessment and will therefore vary widely in scope and detail; will focus on middle term (15 to 25 years) needs and desires; will involve Federal, State, and local interests in plan development; and will identify and recommend action plans and programs to be pursued by individual Federal, State, and local entities.

LEVEL C IMPLEMENTATION STUDIES - Implementation studies are program or project feasibility studies generally undertaken by a single Federal, State, or local entity for the purpose of authorization or development of plan implementation. These studies are conducted under normal Federal, State, or local agency responsibilities and authorities, and implement findings, conclusions, and recommendations of assessments and regional plans found needed in the next 10 to 15 years.

LOAD - The amount of power delivered to a given point.

Base Load - The minimum load in a stated period of time.

Firm Load - That part of the system load which must be met on demand.

Peak Load - Literally, the maximum load in a stated period of time. Sometimes the term is used in a general sense to describe that portion of the load above the base load.

MEAN LOWER LOW WATER - Tides of the northeastern Pacific Ocean are characterized as mixed, with two unequal highs and two unequal lows daily. The plane of reference for navigation channels is the long term average of the daily lower lows, termed mean lower low water.

MGD (MILLIONS OF GALLONS PER DAY) - A flow of one mgd for one year equals 1,122 acre-feet. Also one mgd equals 1.55 cfs.

MG/l - Milligrams per liter.

MINERAL FUELS - Naturally occurring carbonaceous minerals that include petroleum, coal, and natural gas.

NEED - The quantity of a service, commodity, or resource required to satisfy a projected essential requirement and objective, a goal or even a desire.

OBERS - Office of Business Economics, Department of Commerce; Economic Research Service, Department of Agriculture.

OTHER LAND - All land not classified as cropland, rangeland, or forest land is included in this group. Other land includes barren and industrial urban areas, farmsteads, roads, railroads, airports, water surfaces under 40 acres in size or less than 1/8 mile wide, etc.

PE (POPULATION EQUIVALENT) - The measure of the strength of a waste effluent converted to an equivalent number of people which would be required to produce the same biochemical oxygen demand in one day. One PE is 0.16 of a pound per day of biochemical oxygen demand as exerted by the wastes from one person.

PRIMARY WASTE TREATMENT - The removal of settleable, suspended, and floatable solids from waste water by the application of mechanical and/or gravitational forces.

PUMPED STORAGE PLANT - A hydroelectric powerplant which generates electric energy for peak load use by utilizing water pumped into a storage reservoir during off-peak periods.

RELATED LAND - In connection with studies of water and related land resources, "related land" is: (1) that land on which projected use and/or management practices may cause significant effects on the runoff and/or quantity and/or quality of the water resource to which it relates; (2) that land the use or management of which is significantly affected by or depends on existing and/or proposed measures for the management, development, or use of the water resource to which it relates.

RANGELAND - Land in grass or other long-term forage growth of native species used primarily for grazing. It may contain trees with less than 10 percent canopy. It includes grassland, land in perennial forbs, sagebrush land, and brushland other than sage.

RETURN FLOW (IRRIGATION) - Irrigation water applied to an area which is not consumed in evaporation or transpiration and returns to a surface stream or ground-water aquifer.

RUNOFF - That part of the precipitation that appears in surface streams. It is the same as streamflow unaffected by artificial diversions, storage or other works of man in or on the stream channels.

RURAL-DOMESTIC WATER - The rural domestic category includes water uses for domestic needs, stock watering, yard irrigation, etc., of individual homes, farms or ranches, and rural centers with a population of less than about 250 people.

SALMONID - Refers to fish of the family Salmonidae. Includes salmons, trouts, whitefish, and char.

SECONDARY WASTE TREATMENT - The removal of dissolved and colloidal materials that in their unaltered state, as found in waste water, are not amenable to separation through the application of primary treatment.

SEDIMENT - (1) Any material transported by water which will ultimately settle to the bottom after the water loses its transporting power. (2) Fine waterborne matter deposited or accumulated in beds.

STANDARD PROJECT FLOOD - A hypothetical flood that might result from the most severe combination of meteorological and hydrological conditions that are reasonably characteristic of the geographical region involved. The SPF is the usual basis for design of flood control structures.

STREAMFLOW DEPLETION - The amount of water flowing into a valley or onto a particular land area, minus the amount of water that flows out of the valley or off from the particular land area.

TERTIARY OR ADVANCED WATER TREATMENT - Selective application of biological, physical, and chemical separation processes to effect removal of organic and inorganic substances that resist conventional treatment practices.

THERMAL PLANT - A power generating plant which uses heat to produce energy. Such plants may burn fossil fuels or use nuclear energy to produce the necessary thermal energy.

TYPE 1 STUDY - These are studies of a region coordinated by a river basin commission or other Federal interagency-State coordinating organization that provide economic projections of economic development, translation of such projections into demands for water and related land resource uses, hydrologic projections of water availability, both as to quantity and quality, and projections of related land resource availability, so as to outline the characteristics of projected water and related land resources problems and the general approaches that appear appropriate for their solution. Such framework studies would provide general guides to future water resource development. In addition to indicating which regions, or subbasins within them have water problems calling for prompt detailed planning efforts as well as those where no such problems are current or looming, such studies will provide a substantial contribution of fact and analysis to subsequent detailed plan formulation.

TYPE 2 STUDY - These are studies of feasibility or survey scope for individual river basins, tributary basins, or subregions. They are used for areas with complex problems needing concerted multi-agency action for their solution. For areas not previously covered by Type 1 studies, they encompass the features of the Type 1 study, plus the refinements and details of the feasibility or survey scope study. In cases where the Type 2 study area has been covered by Type 1 studies, pertinent features of the latter are summarized as needed for continuation into feasibility or survey scope studies. Type 2 studies are coordinated by a river basin commission or other Federal interagency-State coordinating organization. Such studies define or evaluate projects and programs in sufficient detail to comprise a basis for authorization or implementation of those projects to be initiated in the next 10 or 15 years.

URBAN POPULATION - All persons living in (a) places of 2,500 inhabitants or more incorporated as cities and towns; and (b) the densely settled urban fringe, whether incorporated or unincorporated, or urbanized areas. All other are classed as rural.

WATER AREA - Water areas of more than 40 acres and water courses more than 1/8 mile wide.

WATER RELATED RECREATION ACTIVITY - A recreation activity dependent on or enhanced by water, including swimming, all boating, water skiing, fishing, picnicking, camping, sightseeing, hiking and nature walks.

WATERSHED PROJECT - Comprehensive program of structural and non-structural measures to preserve or restore a watershed to good hydrologic conditions. These measures may include detention reservoirs, dikes, channels, contour trenches, terraces, furrows, gully plugs, revegetation, and possibly other practices to reduce flood peaks and sediment production.

WATERSHED PROTECTION - The treatment of watershed lands in accordance with such predetermined objectives as the control of erosion, streamflow, and floods and improvement of water, forage, or timber yield.

WATER YIELD - Runoff, including ground-water outflow that appears in the stream, plus ground-water outflow that leaves the basin underground. Water yield is the precipitation minus the evapotranspiration.

PARTICIPATING STATES AND AGENCIES

STATES

Idaho	Nevada	Utah	Wyoming
Montana	Oregon	Washington	

FEDERAL AGENCIES

Department of Agriculture
- Economic Research Service
- Forest Service
- Soil Conservation Service

Department of the Army
- Corps of Engineers

Department of Commerce
- Economic Development Adm.
- National Oceanic & Atmospheric Administration
  - National Weather Service
  - National Marine Fisheries Service

Department of Health, Education, & Welfare
- Public Health Service

Department of Housing & Urban Development

Department of Transportation

Department of the Interior
- Bonneville Power Adm.
- Bureau of Indian Affairs
- Bureau of Land Management
- Bureau of Mines
- Bureau of Outdoor Recreation
- Bureau of Reclamation
- Fish and Wildlife Service
- Geological Survey
- National Park Service

Department of Labor

Environmental Protection Agency

Federal Power Commission